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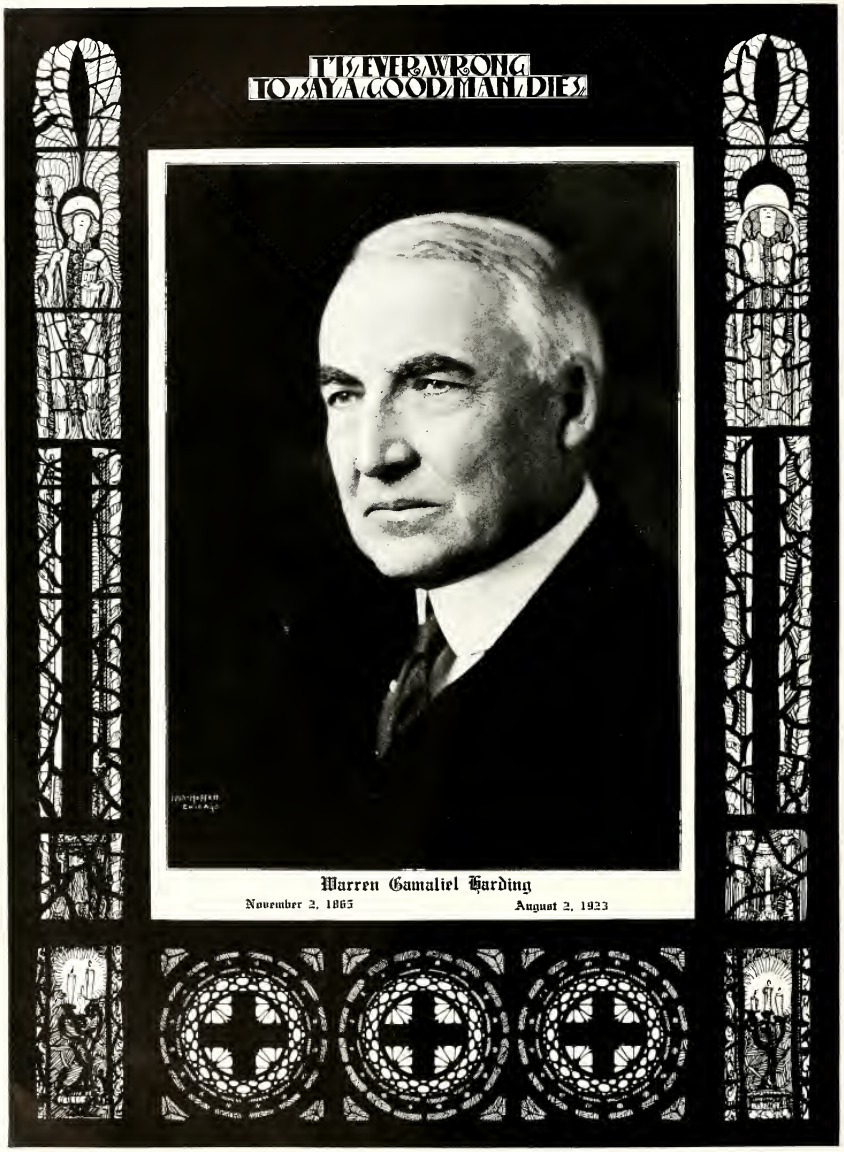

Warren Gamaliel Harding

November 2, 1865 August 2, 1923

Dedication

To the Memory of

WARREN GAMALIEL HARDING

Twenty-Eighth President

of the

United States of America,

True American Patriot,

Beloved Leader of Men;

This Fifteenth Volume of

The Armour Engineer

Is reverently dedicated.

■■■

An Appreciation

WARREN G. HARDING was not merely the leader but the friend of his fellow countrymen.

When he came into responsibility as President he faced unprecedented problems of domestic rehabilitation. It was a time when war stirred emotions had created bitter prejudices and conflict in thought. Kindly and genial, but inflexible in his devotion to duty, he was strong in his determination to restore confidence and secure progress. All this he accomplished through patient conciliation and friendly good will for he felt deeply that hard driving might open unhealable breaches among our people. We have all benefited by the success of his efforts.

He undertook this task of post-war reconstruction at a time when our foreign relations presented many complicated and difficult questions. In meeting these issues he removed causes of misunderstanding and he convinced the nations of both hemispheres of the unselfish and friendly attitude of the United States.

To perform this great service for his fellow countrymen he worked without thought of self, until at last his physical endurance gave way under the strain of his efforts for the welfare of the nation.

Herbert Hoover

The Thing That Couldn't be Done

SOMEBODY said it couldn't be done,
But he with a chuckle, replied
That maybe it couldn't, but he would be one
Who wouldn't say so till he'd tried.
He waded right in with a trace of a grin
On his face—if he worried he hid it,
And started to sing as he tackled the thing
That couldn't be done—and he did it.

Somebody said, "Oh you'll never do that,
At least no one ever has done it;"
But he took off his coat and took off his hat
And the first thing that we knew, he'd begun it,
With a lift of the chin and a bit of a grin
Without any doubting or "quit it"
He started to sing as he tackled the thing
That couldn't be done—and he did it.

There are thousands to tell you it cannot be done,
There are thousands to prophesy failure,
There are thousands to point out to you, one by one,
The dangers that wait to assail you,
But just buckle in with a bit of a grin,
Take off your coat and go to it.
Start in to sing as you tackle the thing
That cannot be done—and you'll do it.

THE ARMOUR ENGINEER

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THE RESPONSIBILITY OF EDUCATION

By

MORTIMER ELWIN COOLEY, M.E., LL.D., Eng.D., D.Sc.

Dean of the College of Engineering, University of Michigan

A GREAT many people are asking themselves these days — What has the future in store for us in view of the great upheaval the world has suffered during the past 10 years? None of us knows the answer. It is like going into an unknown country. A trail must be blazed by those whose wisdom and experience may possibly have qualified them to act as guides. And these naturally may be looked for among the older men — particularly among those who have been students of world affairs. Of one thing we may be certain—old and young alike. As the future in store for us today looks to be different from the future as seen 20 years ago, so it may be reasoned that the education in preparation for that future must be different from the education thought necessary 20 years ago.

Since 40 years ago there have come into being mechanical, electrical, chemical and the other branches of engineering, now side-by-side with civil engineering. In consequence the curriculum has been greatly modified. Room no longer exists in the 4-year college course for the more liberal training common in those earlier days. We now have only time to make of ourselves specialists, and barely time for that we think. This specialization is not confined to engineering but has become general. Comparatively few now-a-days seek an education for education's sake. Fewer still seek an education as preparation for the problems of the future apart from the problem of earning a living—the bread-and-butter problem of life. There should be other objects, one of which is to enable us to see life in its broader aspects; not only as it concerns us personally, but as it concerns others with whom we come in contact—with whom we live. Indeed contacts with others may in the future become a controlling factor in education.

The declaration of the Founders of one of our state universities contains

Dr. M. E. Cooley, who received the Honorary Degree of Doctor of Science, the last of his long series of degrees, at Armour Institute of Technology on May 31, 1923.

this language in expressing the object of the university:

"Providing the best and most efficient means of imparting to young men and young women, on equal terms, a liberal education and thorough knowledge of the different branches of literature, the arts and science, with their various applications."

A writer commenting on this declaration, particularly the phrase "liberal education" said:

"I take that to mean the development of the *man*. It means more, much more than educating a man to be a bread-winner, whether in the professions or in the so-called business world. If he applies himself even to liberal studies merely for utilitarian reasons he is never educated. He has neglected a curious, yet simple thing, the cry of the mind for satisfactions of itself or from the world of knowledge which he can make his own. Through such satisfactions culture comes. Without them, laws of God and Man are to him but scraps of paper. For him no voice of nature is heard; no rhyme or reason, no poet or philosopher finds him at home."

Speaking in general of modern education (not confining it to engineers) it may be said that it trains us how to earn dollars but not how to spend them. You of the younger generation will not mind this for a time, for dollars are today, more than ever before, necessary. But later on when it is to be expected you will have accumulated a considerable number of dollars—more than your daily needs—you will be wondering what to do with the surplus. (Let us hope so anyhow.) You will be casting about for something of more than passing interest. You will naturally think back to your college days and of things you possibly studied outside of your preparation for your bread-and-butter work. And fortunate indeed will you be if you search not in vain. If you have found the time to pursue studies not preceded by the dollar sign which you perhaps chose just because you fancied them and were half ashamed fearing discovery, I venture to predict that such studies will in the future afford you the utmost satisfaction. They will have taught you how better to spend your dollars. Your wife and children will bless you as the wise husband and father who is able to talk in the home something besides "shop." In telling your little ones the story of Jack and the Bean Stalk you will not need to bring in derricks and pile drivers.

I have a very dear friend who has been unusually successful as an engineer. His success is due not so much to an engineering training as because he came into the engineering college with an A. B. degree—the degree by the way of the old-fashioned classical course which contained 6 to 7 years of Latin and 3 or 4 of Greek, with other studies such as history, philosophy, music, art, most of which are today considered *impedimenta* for business. Yet, strange as it may seem to you, that same classically trained gentleman owes his success to these quite as much, if not more, than to his engineering training. His charming personality, his knowledge of things other people know about have made him welcome among those who have money to spend in ways requiring the services of engineers. Almost his first important work came from a friend who with difficulty could be made to understand that this young man was an engineer. He said: "I have been meeting him for years in clubs and at dinners and have heard him read most interesting papers on art, and travel in Italy, Japan, and China, yet never a word of engineering have I heard him utter. If as you say he is an engineer he is the very man I am looking for and he can have charge of the half million dollar factory I am going to build." If then this broader training I am contending for teaches how to spend dollars in order to get the most out of them also teaches how to earn dollars, what is there left to be said in favor of the highly specialized training which teaches only how to earn dollars?

If, gentlemen, what I am saying seems like criticism of your training, I ask you to remember that it is in preparation for the message I have come here to deliver. If heeded, particularly by the younger men present, you will find yourself in the course of fifteen or twenty years playing quite a different part in the world's affairs from that which you presumably now contemplate.

And now a word on the great need of the engineering profession as I see it. Perhaps the most vital need is to get into more intimate personal contact with the public which the engineer serves. Not long since I met a gentleman who inquired of me whether or not engineering was one of the learned professions—like the law, the ministry and medicine. It was a poser but I replied promptly that so far as preparation in the schools and colleges was concerned it certainly was a learned profession. Later I pondered the question and the answer came. It will I am sure surprise you as much as it did me. The lawyer, the minister, and the doctor in serving the public render a direct personal service, that is, come into direct personal contact with the person served—thus are known intimately. But this is not true of the engineer. He rarely comes into direct personal contact with the public served by him. Take for instance the electric light, the telephone, the radio; take the railroads, the steamships, the automobile; and take the heating and plumbing of our homes. These and many others for which the engineer is responsible are absolute necessities in our civilization —indeed in the material sense are what make it. Yet does anyone using these necessities ever think of the engineer who brought them to perfection? No, not often. The plumber is better known to the public than the engineer, for he comes into the home; and contact with him is emphasized when his bill comes in.

It is the purpose of THE ENGINEER to present a number of articles, during the year, on subjects allied with business, law, and administration, which cannot be covered in the curriculum, but which nevertheless form an integral part of every engineer's education.

Of particular interest, in the next issue, will be an article on present day business conditions by Mr. Arthur Reynolds, President of the Continental and Commercial National Bank. Aside from its value as a barometer of the present, it points the way to analysis of the future; and in this latter respect is of utmost significance to the undergraduates who will shortly take their places in the industrial and business world.

Articles of this type are prepared by authorities in their respective lines, and expressly for THE ENGINEER. Don't cheat yourself by missing any of them.

As a result of this involuntary aloofness, the engineering profession has suffered in that it has not rendered another great service of which it is capable. This fact is gradually being appreciated. Organized efforts are being made to bring the engineer into movements for the public good where, because of his special training and his habit of thinking things through, he can render a service no other can. Let me cite an example. You are all aware in a casual way of the splendid efforts of the Forestry Service to bring home to the people that unless reforestation is undertaken promptly and on a gigantic scale there will be no forests in 60 or 70 years. They will disappear with your own children when they grow old and die. We are using timber four and one-half times as fast as it grows. Yet, these vital facts are not comprehended by our people. While they have been told and told again no impression seems to have been made. The people must be awakened to this great menace. The engineers of the country are now organizing to back the Forestry Service, and if plans proposed can be successfully carried out 200,000 engineers will be carrying the message into the homes from one end of the country to the other. Mr. Charles H. MacDowell, president of the Armour Fertilizer Company is the chairman of the committee charged with this great work.

Just now a committee of engineers has been appointed to make a study of the storage of coal. The idea is that by securing our coal and storing it early in the season, instead of waiting until cold weather comes, the production of coal in the mines can be stabilized. Fewer miners would be needed and they would work throughout the year instead of only part time as now. This investigation is being made in conjunction with other agencies each charged with some part of the general investigation which is nation-wide in scope. Mr. W. L. Abbott, Chief Engineer of the Chicago Edison Company, is the chairman of the engineer committee. Another example of the work which engineers may do in the interest of the public has to do with the great transportation question in this country. Several organizations are already at work, and the question is now being considered, whether or not engineers if organized could, because of their special knowledge and training contribute something of value to the investigation. Obviously they could. But these examples have to do with our country—our fraction of the world—so lightly touched by the destroying demon of war. Is there not something engineers could do that would be world-wide in extent? I am sure there is. But are we, as a profession, prepared?

I cannot answer this question further than to say yes and no. On the technical side we are. But on questions involving knowledge of peoples differing widely in their national characteristics and what has produced those differences, on questions political, social and economic, engineers cannot qualify so well, if indeed they can qualify at all. Thus it might, and probably would, require years of study and training to enable the profession to contribute, in the manner customary to engineers, a substantial service of this character.

But, you are saying to yourselves, "Why should engineers do this? Why not leave it to others? We have our own work to do." So we have. And so have the others. But we and the

(Continued on page 31)

THE GRADING OF COLLEGE STUDENTS

By

H. R. PHALEN

Associate Professor of Mathematics

THERE is no more vivid illustration of absolute confusion than the present status of grading students in American Colleges. Administrative officers, registrars, and examiners will unanimously bear witness to the remark, and will further agree that patience, temper, and religion, all become lost in the attempt to adjudicate the relative values of grades being transferred from one school to another. The marking of a student appears to be a problem possessing the paradoxical properties of being necessary, important, pernicious and futile.

It will be the purpose of this paper to point out certain causes for the existing condition, to give in some detail an exposition of the underlying principles of the theory of probability and correlation, as they would apply to a scientific study of the problem, and to make some contructive suggestions as to a partial alleviation of the situation.

To the author's notion the first and greatest source of trouble lies in the fundamental fact that human beings cannot be placed in a simple ordinal arrangement. The utmost duffer at a fame of billiards may very well be the world's greatest aviator; the vilest of singers may excel as an artisan, and it is well for the race that it is so. Nevertheless the present generation in its pursuit of efficiency has thrust into the general mind the idea that all things can be catalogued by a single label. In the collegiate world the students and faculty alike have come to believe that it is the business of the college to turn out a certain number of what might be termed "educational bombs," since each one is supposed to be loaded with specific facts of given calipered dimensions which were put in, and hence must come according to a rigid formula. This whole notion violates the childishly obvious fact that intelligence is a multi-partite property of the human being. Anyone who challenges the statement is invited to arrange in indisputable order such individuals as Archimedes, Newton, Wagner, Angelo, Luther, Harvey, Leighty, Shakespeare, and Disraeli. The natural and proper query to such a challenge is, "What do you mean?" The answer is, "I don't know." This in itself it would seem were quite sufficient; but the process is carried to the stage where all the grades are averaged and upon that basis the student elected to one or more honorary societies. This scheme rests upon the hypothesis that all courses are equally difficult and that in each course the judgment of the teacher is infallible. Both assumptions are ridiculous and lead to amusing results, such as those which follow.

Shakespeare, we are aware from his writings, possessed what might be termed a "gentleman's" knowledge of science, music, art, biology, law, theology, and statesmanship. In none of them, however, is it probable that he could have passed satisfactorily an examination written by a professor of the subject. His report card might have presented this appearance had he attended college:

Prof. H. R. Phalen.

Mathematics	40%
Physics	50%
Biology	60%
Music	50%
History	90%
Literature	100%
Political Science	80%

The obvious conclusion is that Shakespeare as a factor in human society and as an aid to his fellow men could not hope to be above mediocre. Fortunately for the great mass of students, the deduction is erroneous. Otherwise only a Leonardo da Vinci could hope to qualify.

A fanciful but applicable illustration is that of the experience of Mr. Cube. Seems that Mr. Cube was one inch on an edge, and that when he entered college he first attended the class taught by Prof. Length. Now Prof. Length had settled it in his own mind after years of mental agony that a line two inches long represented perfection. Accordingly he applied his standard to one edge of Mr. Cube and graded him 50 per cent. Next the student attended the class taught by Prof. Area whose standard of perfection was any polygon whatsoever having an area of one square inch. He regarded Mr. Cube as a most excellent pupil and marked him one hundred per cent. The next class was with Prof. Volume, whose ideal was a solid containing ten cubic inches. In this class poor Cube failed utterly with a grade of ten per cent. The drama closed most dismally when Cube was told at the end of the semester that his average was 53⅓ per cent, and that he had better devote his energies to other things. Consequently he woefully passed out, pondering meanwhile the peculiar fact that if instead of being a cube he had been a parallelopiped of dimensions 2"x½"x1" he could, by the simple device of entering Prof. Length's class sidewise, have raised his average to 70 per cent, and would, doubtless, have been permitted to remain.

So far as any tangible evidence or data is concerned there is no correlation between the marks a man gets in college and the success he has in after life. To be sure there are many instances where honor men in scholarship have become distinguished in the world at large, but the cases are equally numerous where mediocre students and even flat failures have been requested to accept honorary degrees in later years.

The preceding remarks may appeal to certain readers in the light af facetious, destructive criticism. If so the author regrets his inability properly to express the fact that the placing of any individual in any particular niche is an impossibility.

The general run of students, however, desire the impossible. They seek a criterion by which they may compare themselves with their fellows, even though the system be admittedly faulty. Competition is, perhaps, the greatest incentive to human endeavor, and hence the marking system is in vogue, and though insufficient is better than nothing. Like the English system of

units, it is too expensive and too firmly established to be eliminated.

The question resolves itself to this: accepting some sort of a grading system as a necessary evil, how should it be operated? In this connection two methods present themselves, both of which are in use.

METHOD I: Make the system as simple as possible by having two marks only, namely, P for passed, and F for failure. To the author's notion this is by far the most sensible, and has the advantage that odious comparisons are eliminated. If when a student is ready to graduate his department faculty see fit to grant him the distinction of *summa cum laude* or *magna cum laude* upon general impressions, there is every reason to believe that such judgment would be as fair and just as by the present method of clerical manipulation and computation.

It must be admitted that this scheme has the disadvantage that it is not in general use and has opposed to it the inertia of generations of collegiate instruction.

METHOD II: If it is decided to adhere to the present general method of marking by percentage or by the use of grade intervals of the A, B, C, D, E, type, it must be recognized at the outset that the following factors are constantly at work tending to make the results fallacious.

(a) Teachers having classes in the same subject do not mark alike.

(b) The effort requisite to obtain a passing grade differs with different courses.

(c) Standards differ from school to school.

(d) Certain courses are unadaptable to precise judgment.

In order that Method II may produce any results, it must be sufficiently elaborated to cover the problem. This means that each teacher must concur in the scheme and that some agreement must be reached whereby as high a degree of uniformity as possible may be reached. Obviously the whole structure falls if one instructor holds weekly quizzes and makes every reasonable effort to know just what his students are doing, while another makes simply a random guess at the end of a course of pure lectures.

Secondly, an attempt must be made to equalize the effort requisite to obtain the same grade in different courses. In certain institutions there are what are termed by the students "Phi Beta Kappa" courses, because those seeking high records in scholarship in candidacy for election to honorary academic societies always take them. The author knows personally of one instance where over a period of four years a certain professor gave twenty-eight C's out of a total of five hundred marks. The remaining four hundred and seventy-two grades were divided about equally between A's and B's. The course was wholly lectures with no final examination, and was naturally very popular with students seeking "honors." Those who have a sense of humor will appreciate the validity of the results obtained when such grades are combined with those in Physics, Mathematics, or Zoology, to compute an average to several decimal places, in order to determine whether a student rates third or fourth in a class.

No system of percentage grading means anything more than a manipulation of figures unless every precaution is taken to approximate uniformity. Under the present methods of operating the American College the labor entailed in any scientific approach to the question is prohibitive, and moreover the detail involved would be incommensurate with the value of the results.

It may, however, be enlighting to some to get a glimpse of the technique of a superficial study of one isolated phase of the problem, namely, the question of the relation between the class grade and the final examination grade.

In order to proceed logically it will be necessary to consider in order, three things: (I) frequency curves, (II) Gaussian distribution, (III) "coefficient of correlation."

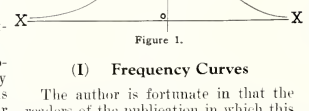


Figure 1.

(I) Frequency Curves

The author is fortunate in that the readers of the publication in which this article will appear, are already familiar with the graphical recording of data. They have plotted curves of many kinds and for various purposes, and hence it will be unnecessary to dwell at length upon introductory details.

A frequency curve is just what its name implies. On the horizontal axis we lay off what are called the "phases" of the property under consideration, and on the vertical axis we lay off the number of individuals exhibiting the various phases. In order to make the terms more clear, suppose it is desired to record geographically the number of students born in each month of the year. On the horizontal axis we would lay off twelve equal intervals, and in the middle of each one erect as an ordinate the number of students born in the corresponding month. Suppose 63 were born in August. In the language of statistics we would say that the frequency of the August phase of the property was 63.

Obviously such a graph as that just mentioned would be irregular. There are, however, distributions which exhibit typical characteristics and are interesting, and useful in addition. Certain of the more important ones will be briefly treated as an introduction to the theory which is to follow.

The Symmetrical Distribution

In this type, shown by Figure 1, the class frequencies decrease to zero symmetrically on either side of a central maximum. Such curves are very closely approximated in many kinds of investigations involving measurements along biological lines. For instance a tabulation of the weights of ten thousand men would yield such a graph. The weight having the highest frequency would very likely be about 150, while there would be, on the one hand, a few weighing 90 lbs., and on the other, an equally small number weighing 300 lbs. This curve is the most important one in the whole theory of statistics and probability, and will be more fully discussed subsequently. In passing, it is of interest to note that the coefficients of the binomial expansion $(a+b)^n$ group themselves in this manner, if n be a positive integer. In particular if we take a=1, and b=1, and let n range from 1 up to any desired number, we get

$$(1+1)^1=1+1$$
$$(1+1)^2=1+2+1$$
$$(1+1)^3=1+3+3+1$$

and so on. These results may be more vividly arranged in what is known as a Pascal triangle, as shown below,

1 1
1 2 1
1 3 3 1
1 4 6 4 1

where each row is obtained from the one above by adding consecutive pairs. In any event the result gives a series of numbers which exhibit the fundamental characterisitics of a symmetric distribution.

Asymmetrical or J-Shaped Distribution

Figure 2 is the result of plotting the frequency of deaths from diphtheria. Since the disease is primarily contracted by infants the shape of the curve is readily explained.

The U-Shaped Frequency Curve

This is a type of rare occurrence but of interesting form. Figure 3 is copied from a record of cloudiness over a period 3,653 days, and shows that

cloudy days and clear days predominate over partly cloudy days at the place where the observations were made.

The distributions which are irregular are unlimited, and any attempt to classify them would be useless, but perhaps the foregoing exceedingly untechnical discussion will serve to indicate what is meant by a frequency curve.

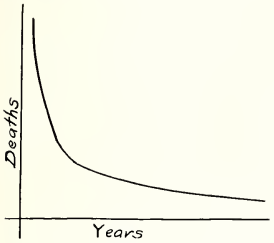


Figure 2.

(II) Gaussian Distribution

It may be said in a popular way that any set of data which gives a symmetrical curve of the type shown in figure 1 is a "Gaussian distribution." The name comes from the fact that Gauss made an exhaustive study of this type of curve and derived its equation from the standpoint of the frequency of occurrence of errors. The proof in full can be read in Merriman's "Method of Least Squares," page 22, but the outline of it will be given here for completeness.

Gauss' demonstration is based upon the hypothesis that the most probable value of a quantity which is observed with equal care several times, is the arithmetical mean of the measurements. That is if M_1, M_2, M_3 . . . . M_n are the n measurements of a quantity z, the best value of z is

$$z = \frac{M_1 + M_2 + M_3 + \ldots . M_n}{n} \qquad (1)$$

This equation may be written

$$nz = M_1 + M_2 + M_3 + \ldots . M_n \qquad (2)$$

Since, however, there are n of the z's we may combine each z with an M and write:

$$(z - M_1) + (z - M_2) + (z - M_3) + \ldots . \\ (z - M_n) = 0 \qquad (3)$$

But the differences $(z - M_i)$, where i 1, 2, 3, . . n, are called residuals, and hence we have the theorem that the algebraic sum of the residuals is zero. The importance of this fact will appear in the proof.

Suppose we desire to make n measurements upon a quantity z in order to determine its most probable value. The differences between the observations and the true value of z are called errors, which will be designated as x_1, x_2, x_3 . . . x_n. The probabilities of these errors are $y_1 = f(x_1)$; $y_2 = f(x_2)$; $y_3 = f(x_3)$; up to $y_n = f(x_n)$. The probability of committing the given system of errors is

$$P = y_1 \cdot y_2 \cdot y_3 \cdot \ldots \cdot y_n = f(x_1) \cdot f(x_2) \cdot f(x_3) \cdot \ldots f(x_n) \qquad (4)$$

since the probability of committing a series of errors is the product of the separate probabilities.

Applying logarithms to the above expression it becomes

$$\log P = \log f(x_1) + \log f(x_2) + \log f(x_3) \ldots + \log f(x_n) \qquad (5)$$

The most probable value of the unknown quantity z is that one which makes P a maximum, and this will occur where the tangent is horizontal, or in other words, where the derivative of log P is zero. Hence, differentiating (5) and equating to zero gives

$$\frac{1}{P}\frac{dP}{dz} = \frac{1}{f(x_1)} \cdot \frac{df(x_1)}{dz} + \frac{1}{f(x_2)} \cdot \frac{df(x_2)}{dz} + \ldots \frac{1}{f(x_n)} \cdot \frac{df(x_n)}{dz} = 0 \qquad (6)$$

Since in general the derivative of a function may be written as the product of that function by another properly chosen one, or since

$$\frac{df(x)}{dx} = f(x) \cdot \phi(x)$$

whence $df(x) = f(x) \cdot \phi(x) \cdot dx \qquad (6a)$

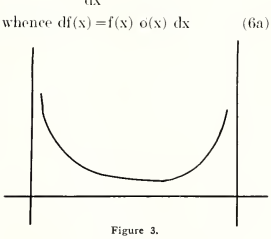


Figure 3.

We may replace $df(x_1)$ by $\phi(x_1) f(x_1) dx$, etc., and get

$$\phi(x_1)\frac{dx_1}{dz} + \phi(x_2)\frac{dx_2}{dz} + \ldots \\ \phi(x_n)\frac{dx_n}{dz} = 0 \qquad (7)$$

Now if the measurements made upon z are M_1, M_2, M_3 . . M_n, the errors are $x_1 = z - M_1$; $x_2 = z - M_2$; . . . $x_n = z - M_n$, etc., from which

$$\frac{dx_1}{dz} = \frac{dz}{dz} = 1; \quad \frac{dx_2}{dz} = \frac{dz}{dz} = 1$$

and equation (7) becomes

$$\phi(x_1) + \phi(x_2) + \phi(x_3) + \ldots . \phi(x_n) = 0 \qquad (8)$$

Now if the number of observations be large, the errors are for all practical purposes equal to the residuals, and hence

$$x_1 + x_2 + x_3 + \ldots . x_n = 0$$

because it was established in equation (3) that the algebraic sum of the residuals must be zero.

A consideration of equations (7) and (8) will show that they will agree if

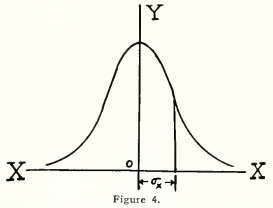


Figure 4.

ϕ signifies multiplication by a constant. Hence

$$\phi(x_1) + \phi(x_2) + \phi(x_3) + \ldots . \phi(x_n) = cx_1 + cx_2 + \ldots . cx_n \qquad (9)$$

Replacing the values of $\phi(x_1)$, $\phi(x_2)$, etc., from (6a), we get

$$\frac{df(x_1)}{f(x_1)\,dx_1} + \frac{df(x_2)}{f(x_2)\,dx_2} + \ldots . = cx_1 + cx_2 + \ldots \qquad (10)$$

Since this is true whatever the number of observations, the corresponding terms in the two members are equal. Hence, if x be any error and $y = f(x)$, we have

$$\frac{df(x)}{f(x)\,dx} = \frac{dy}{ydx} = cx$$

Multiplying by dx gives the simple differential equation

$$\frac{dy}{y} = cx\,dx \qquad (11)$$

from which

$$\log y = \frac{cx^2}{2} + k \qquad (12)$$

Passing from logarithms to numbers we get

$$y = e^{\frac{1}{2}cx^2 + k}$$

which may be written

$$y = e^{\frac{1}{2}cx^2} \cdot e^k$$

Here the constant c must be essentially negative since the probability y should decrease as the error x increases. Replacing c 2 by $-h^2$ and putting $e^k = C$, there results

$$y = Ce^{-h^2x^2} \qquad (13)$$

which is Gauss' equation for the law of probability for errors of observation. If we plot the curve of the Gauss' equation

the result is as shown in figure 4. Any set of data which gives such a curve will in general be what is known as a Guassian distribution, and will lend itself to the formulas and theorems which will be treated later.

The abscissa of the inflection point is of so much importance that it has a special name. It is called "standard deviation," and is denoted by σ_x. If by methods of elementary calculus we equate the second derivative of equation (13) to zero we get,

$$\frac{d^2y}{dx^2} = 2h^2Ce^{-h^2x^2}(2h^2x^2-1) = 0$$

whence $2h^2x^2-1=0$

and $x = \pm\frac{1}{h\sqrt{2}}$

Consequently $\sigma_x^2 = \frac{1}{2h^2}$

and hence in modern texts the Gauss' equation is written

$$y = Ce^{\frac{x^2}{2\sigma^2}} \qquad (14)$$

All the foregoing derivation may appear to some as being beside the question. In order that the thread of the argument may not be lost the reader is reminded that the general theory of marking is one which involves two variables. The Gaussian equation in one variable, i. e. equation (14) is the foundation upon which will presently be erected the theory of two variables.

(III) The Gaussian Distribution in Two Variables

In the derivation of the Gauss' curve we plotted the property phases on the X-axis, and the frequencies on the Y-axis. Suppose now we wish to consider two properties simultaneously, with the idea in mind of seeing whether any relationship exists between them. Table 1, which contains the data relative to the ages of husband and wife of 5,317,000 pairs in England in 1901 will illustrate what is meant.

The numbers from 15 to 85 in the first horizontal row give the ages of the wives, and the numbers in the extreme left hand column give the ages of the husbands. The numbers in the body of the table give the frequencies in thousand for each phase combination. For instance, there were 2,000 cases where both husband and wife were 15 years old or less; there were 1,000 cases where

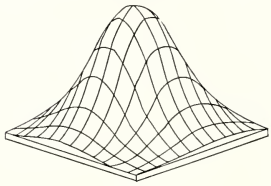


Figure 5.

the husband was 25-30 and the wife 45-50. To represent this data graphically requires three dimensions, say the X-axis for the wife ages, the Y-axis for the husband ages, and the Z-axis for the frequencies. The result will be a surface, a sort of mountain-shaped affair, with its base on the XY plane. This base curve bears some resemblance to an ellipse with its major axis on the forty five degree line. A casual glance at the table of data will reveal the same fact. There is a decided drift from the upper left hand corner to the lower right hand corner, and the entries lie fairly symmetrically about the diagonal line. This diagonal line might very loosely be called a line through the centers of gravity of the columns. We might also think of the centers of gravity of the rows and thus obtain another line. Of course it never happens with actual data that the centers of gravity, or in other words, "means," of the rows and columns, are colinear, but they are in many cases sufficiently nearly so to warrant investigation. The relation of the two lines is what is called the "coefficient of correlation." Its determination is a piece of mathematics of extreme nicety and of great practical use, if not abused. Unfortunately the modern schools of education have applied the Gauss' method wholesale to cases which violated most, if not all, of the fundamental hypothesis upon which his formulas were based, and have as a consequence disseminated weird and wonderful information to the popular mind regarding the nature of statistics.

To return to the question in hand we may note that if our frequency surface or "mountain" were cut by vertical planes parallel to either the X- or Y-axis the cross sections would be plane curves resembling the Gauss' curve of equation (13). Such a surface is called a Gaussian surface for two variables. Its ideal form is exhibited in figure 5.

If the data, after being properly assembled, satisfies the criteria, of which only the barest outline has been given here, we may proceed to the determination of the correlation from which we may judge what dependence, if any, one of the variables has upon the other.

It is the author's purpose in the next issue to lay the mathematical foundation for finding the correlation coefficient, and to apply the theory to the question of the relation between class grades and final examination grades. To add interest, the data will be taken from actual class records at the Armour Institute of Technology.

Table I

Ages of Wives

Ages of Husbands	15–	20–	25–	30–	35–	40–	45–	50–	55–	60–	65–	70–	75–	80–	85–	
15–	2	2														4
20–	16	117	46	4	1											240
25–	4	185	402	84	10	2	1									688
30–	1	41	265	411	84	12	2	1								817
35–		9	69	251	369	80	12	2	1							793
40–		3	17	71	219	309	66	12	2	1						700
45–		1	6	20	66	178	252	59	10	2	1					595
50–			2	8	19	57	146	195	44	10	2					483
55–			1	3	8	18	46	110	141	35	6	1				369
60–				1	3	8	16	39	81	101	23	4	1			277
65–				1	1	3	6	11	26	53	58	13	2	1		175
70–					1	1	2	5	8	18	31	31	6	1		104
75–						1	1	2	3	5	10	14	12	2		50
80–								1	1	1	2	4	5	3	1	18
85–											1	1	1	1		4
	23	414	808	854	781	669	550	437	317	226	134	68	27	8	1	

"Gladys must be a pretty wild girl."
"How so?"
"I heard her father say he couldn't keep her in clothes."
—Georgia Technique.

A coal man says that some people who buy on time don't seem to know when time leaves off and eternity begins.
—Exchange.

"Here young man, it's against the law to spit on this floor."
"Then why did you put that sign up?"
"What sign?"
"'Fine for Spitting.'" —Gargoyle.

THE TECHNICAL MAN IN THE RUBBER INDUSTRY

By

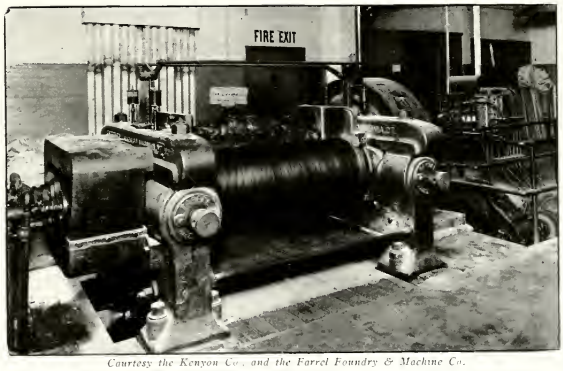
ARNOLD H. SMITH, '17

ALTHOUGH rubber manufacture is among the first of the important industries in the country, it is not yet subject to the technical control, particularly chemical control, that is applied in other industries. One could almost say that the production departments of the industry are carried on without the aid of the chemists. To be sure, there are methods of checking in some departments of rubber manufacturing plants, but these checks are few and are almost entirely simple physical tests. Even the development and research work is done along the lines of physical improvement. In other industries, we also strive for improvement in the physical properties of our products, but once having attained our goal, we usually resort to chemical control in order to maintain it. This is particularly true in the steel industry, where we go so far as to determine the quality of each melt in the open-hearth furnaces before it is run out. In direct contrast, the writer knows of no systematic check generally used in the rubber industry after the preliminary examination of the raw materials, and even this raw material testing is omitted by a very large percentage of the smaller factories.

The work of the technical man naturally divides itself into factory control, factory development and laboratory research.

Factory control work is divided into checking the quality of the raw materials, such as rubbers, fabrics and compounding ingredients; and into checking the various factory operations. These include drying fabrics and compounds, weighing batches, mixing, calendering and tubing, building up of articles, and curing. Factory development work concerns itself with improvement in machines and operations which may save time, labor, or material. It also includes such changes in working formulas which may be necessitated for various reasons. These may be necessary because a change in the time of cure is needed, or perhaps a change in the type of product is wanted. Oftentimes a change in the quality of product is desirable, while occasionally formulas are revised because of fluctuations of costs of compounding ingredients. It is regularly necessary to make minor changes to allow of better factory working conditions. Laboratory research includes research which is directly applicable to factory problems such as the investigation of new materials, as well as pure theoretical research which has no immediate direct bearing.

Probably as great a variety of raw materials are used in the production of rubber goods as are used in any other industry. One large manufacturer of practically every type of rubber article once adopted the slogan of "Everything in Rubber." It was at the time of high priced rubber, when substitutes and reclaims were very much in order. The slogan was so easily and readily construed to mean that for which it was not intended, that it was quickly dropped.



Courtesy the Kenyon Co., and the Farrel Foundry & Machine Co.

THE FARREL MILL

First among the important raw materials is rubber itself. Today about 80% of this comes from the plantations in the far East, the larger part of the remainder from South America (mostly from the Amazon basin), while a small amount still comes from Africa. The plantation rubber is of two main types, smoked sheet and first latex or pale crepe. There are off grades of smoked sheet, and several grades of latex, such as amber or brown crepe, decreasing in value to roll brown crepe which contains considerable tree bark and dirt. Rubber on arrival is inspected for freedom from mold, dirt, or other mechanical impurities. Clean plantation rubber is generally not rewashed in the factory. A representative sample is taken and tested in the laboratory for rate of cure, tensile strength elongation, and type of stress-strain curve. The obtaining of this sample is no simple task, since the contents of any one car may represent almost as many plantations as there are boxes. Quite often the original plantation mark is scraped off the box and the rubber brokers mark stenciled on it. This makes sampling a very difficult task. Far too often it is not done at all. Wild rubber is washed and the washing loss determined. After being washed and dried, it should be tested the same as a sample of clean plantation rubber. Reclaimed rubbers or shoddies are of many types. They may have been reclaimed by the acid, alkali, or softener process. In general the tests on the reclaims are as follows:

1. To determine acidity or alkalinity.

2. To determine specific gravity, tensile strength and elongation when cured.

3. To determine the percentage of free sulfur, if appreciable.

4. To determine roughly the original rubber content by subtracting from 100% the sum of the ash and resin or oil content.

The raw material second in importance in the rubber industry is cotton fabric. The real value here lies in the length of the fiber and in the character of the mill work. The weave of the

fabric is made apparent upon close examination. The construction, percentage crimp in both directions, tensile and elongation at break are the things to be checked. The tensile strength is the most important test (particularly for tire work), and is made under a definite humidity condition. The twist in the yarn is also very important. Tire cords must withstand quite an elongation before rupture takes place.

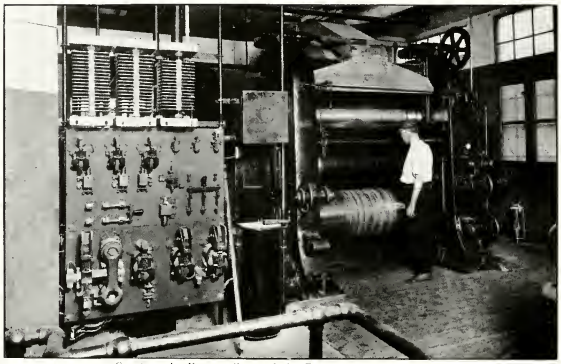
The various compounding ingredients are altogether too numerous to describe any individual tests. Types of tests for general classes will be mentioned. They can be classified roughly into dry powdered material, softeners, and accelerators. The dry powdered materials, somewhat in order of their importance, are zinc oxide, carbon black, clay, whiting, litharge, iron oxide, magnesium oxide and carbonate, lithopone, lime, antimony sulfides, barytes and blanc fixe, tripoli, asbestine, white lead, powdered slate, plaster of paris, various mineral colors, and quite a variety of lesser used minerals and by-products. In general they must conform to the following tests:

1. Fineness of particle. The finer the particle the more valuable the material.

2. Freedom from alkalinity or acidity. Thus by-product whiting should be free from sodium hydroxide; red oxide of iron free from sulfuric acid, etc.

3. Freedom from foreign particles such as lumps of unground material, splinters, cords or nails from the containers, etc.

It has been found that practically any material which can be produced economically and of fine particle size can find its place in the rubber plants. It is noteworthy that the two finest materials, carbon or gas black, and zinc oxide enjoy the most extensive use because, in the rubber technical man's language, they reinforce the rubber. Therefore a much higher volume cost (pound cost times specific gravity) is paid for these materials. Certain clays reinforce rubber, but have the unfortunate defect of also causing the rubber to lose a large part of its resistance to tear. For this reason although clays are widely used, in the better grade stocks they are always compounded in conjunction with carbon black and zinc oxide.



Courtesy the Kenyon Co., and the Farrel Foundry & Machine Co.

THE FARREL CALENDER

Softeners include the so-called mineral rubbers, usually oxidized petroleum still residues with or without fluxing with gilsonite, various vegetable and mineral oils, resins, rubber substitute (a reaction product of vegetable oil and sulfur or sulfur chloride), a number of tars and pitches, and most any oily or greasy by-product which is cheap in cost. The only requirements of materials of this class are that the various shipments must be uniform, and the products must be free from mineral acid or strong alkali. Fatty acids are permissible, stearic acid itself oftentimes being used. The melting point of the mineral rubber, and the percentage of free oil in the rubber substitute, are usually checked. These two are quite generally used as cheapeners, the mineral rubber practically replacing substitute in late years except in light colored goods. The other oils, resins, pitches, etc., are customarily used only in the amounts of from 2% to 8% of the weight of rubber. This is to soften the rubber to facilitate working in the factory, and to prevent the added sulfur from working to the surface of the goods (blooming) before curing.

There are many other compounding ingredients which defy classification but are worthy of mention. Glue is widely used in rubber. When containing 10% or more of water, it is incorporated with pure crude rubber on a very hot mill. The water slowly evaporates as the glue works in. Subsequent drying is usually unnecessary. Ground fabric scrap, such as tire fabric trimmings, is much used to make a very stiff and almost unstretchable stock. This has been used in the now not-so-popular rubber soles. Refined, or finely ground cured scrap, such as solid tire treads, etc., finds its way back into the cheaper grade heels and mechanical goods.

The various organic accelerators are tested by one of two methods. If a pure compound, they are tested by the usual methods of organic analysis for purity. They are also examined for fineness of grinding in case they do not melt readily in the cure. If not easily checked on their chemical purity, they are compounded in a certain test formula with a standard lot of rubber, and the rate of cure of this accelerated batch compared to previously set standard.

The responsibility for proper functioning of the factory departments in respect to uniformity of quality of product, falls jointly upon the departmental production heads, and the technical man in charge. Probably, just as in any other industry, the tendency is for the plant man to blame the formulas, and for the technical man to complain of loose operation in case anything goes wrong. The trouble is usually found to be the fact that either the technical

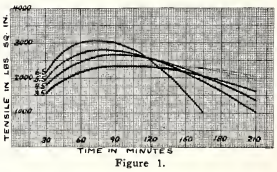


Figure 1.

man is not thoroughly familiar with all of the details of factory operation, or that instructions in the departments are not being followed to the letter. In the former case the technical man tries to cover up his ignorance; and in the latter, the foremen attempt to hide their departments lack of discipline by swearing that the work is properly done. It takes real cooperation here to solve the difficulties that continually arise.

All rubbers, fabrics, and compounding ingredients must be relatively dry

before use. The moisture content of the raw rubber and of the reclaims should not run over 0.6% to 0.75%. Fabrics should have their water content cut from the normal of about 7% to near 1% and should be frictioned while still hot. In general, all compounding ingredients should be thoroughly air-dried. Excess moisture in any such ingredient causes a high vapor pressure in the goods during cure. If excessive, after the applied pressure is removed following the cure, the goods will turn spongy. For the same reason, goods cured without external pressure will gradually sponge during the cure.

Cheap laborers can not ordinarily be trusted to weigh accurately small quantities of important ingredients. In such cases, these are compounded into master batches in which the particular material is only about 10% or less. The percentage accuracy is thus greatly increased. The total quantity of rubbers and compound in any one formula is weighed, usually into a pair of tubs or pans, the one containing the rubbers and the other the powders. It is good practice to check the total weight of the ingredients here, or else check the

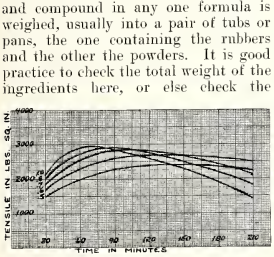


Figure 2.

weight of the batch as it comes from the mill.

The customary procedure for mixing is to put on the rubber and master batches first. As soon as it follows the roll, the mineral rubber or pitches are added. When the roll is covered, any oil or grease is slowly worked in. As soon as the rubber becomes plastic, the whole of the compound, the sulfur occasionally excepted, is dumped on the rolls. At this stage the bank between the rolls should be about the size of a man's arm. If more than this, part of the batch should be cut off. The powders which fall through are shoveled up and are returned to the top of the mill until all are incorporated. In any batch in which there is any tendency for scorching, or premature vulcanization on the mill, the sulfur is held out until almost the end of the mixing. It is then mixed in as quickly as possible, the batch sheeted off, and rapidly cooled. Usually the order of adding the ingredients matters little, but with some batches it is quite possible to double the milling time by not handling the materials judiciously. With other batches a decided variation in final quality may result with varied methods of mixing. It is best to work out a definite method and stick to it. This method is simply the quickest one which will give uniform dispersion of the compound throughout the rubber.

Milled stocks are allowed to cool, then are stored away for a day or more before being "broken down" or "warmed up" for the calender. Stocks should be soft enough to work at a definite speed on the calender or in the tubing machine. Excess heat on the calender should not be required properly to run the stock, nor should the stock be so susceptible to heat as to cause scorching should there be any variation or delay in calender operation. Usually from 2% to 5% of softeners are required in a friction stock to keep it from blooming too heavily before it is cured. The technical man must watch this before-cure bloom on all factory stocks. If it is too much the stocks become dry and necessitate extra time and labor in building. If not enough bloom, the stocks stick to the liners and have to be scrapped or re-run. The most general causes for variation in bloom of stocks are:

1. Differences in temperature of calender rolls.
2. Differences in the "nerve" or softness of the rubber.
3. Length of milling time and
4. Percentage or scrape or re-run stock.

This is all based on the assumption that the stock contains the proper amount of softener to run properly with normal calender or tube machine operation.

The building up of all rubber articles is more or less similar frictioned or frictioned-and-skimmed fabric is laid ply upon ply with itself, or with thin sheets of the proper type of compounded rubber. The different parts must be absolutely clean to insure unions on vulcanization. They should be "tacky" (sticky) to facilitate the building operation. In general, the more tacky, the less trouble is experienced in obtaining a good union of the component parts in the cured article. The completed article is dusted with talc so that it will slide in the mold in which it is cured. If cured in air or open steam, it is left on the form on which it was built.

Until a few years ago, the curing of rubber goods was left entirely to the production foreman, and was by guess or rule-of-thumb methods. Quite often a sample was taken from the heater periodically and when the goods "felt" about right, the heat was called done. In those days the cure was several hours. With the advent of accelerators and present day production methods, a very rigid control is kept on the time and temperature of cure. In rubber factory practice the temperature is ordinarily referred to as so many pounds steam pressure. It is, however, carefully checked with thermometers so that the temperature corresponding to a definite theoretical steam pressure is actually used. On all large heater equipments at present, there are automatic temperature control instruments. These instruments are merely set at the word "start." They regulate the steam supply to give a pre-determined temperature

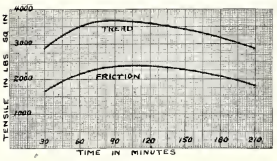


Figure 3.

rise, and a definite temperature over a given period of time. The average tire cure is a 15 minute rise, and 1 hour 30 minutes hold at 40 pounds steam pressure. Some instruments also automatically spray or flood the contents of the heater with cooling water at the end of this time. Inner tubes are usually cured at from 20 minutes at 60 to 70 pounds, to about 1 hour and 10 minutes at 40 pounds, depending on the quantity of accelerator added. Boots and shoes and air cured fabrics have a very slow temperature rise of 2 to 3 hours, and are cured an additional 2 to 4 hours at from 250° to 270° F. Press cured goods are vulcanized much more rapidly, usually from 10 to 25 minutes at from 50 to 80 pounds of steam.

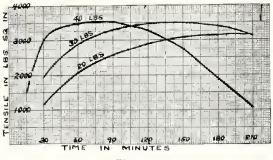


Figure 4.

Ordinarily the more rapidly goods are cured, the better the product; all other things being equal. However, both rubber and fabric are very good heat insulators, and the limiting factor is the time necessary for the heat to penetrate a definite thickness of goods. The cure is thus made as short as possible, but must allow of a fairly uniform heating throughout. On very thick articles the temperature is slowly raised, otherwise the outside would become over-cured before the inside had started to vulcanize.

The foregoing is an extremely brief outline of some of the general problems which come before the technical man in the rubber industry. He is of course charged with the responsibility of seeing that the plant is free from obvious troubles, and as well is looked to for mechanical improvements in plant operation; and for the development of new formulas and compounds. The work is usually divided up so that there is a mechanical engineer in charge of the mechanical end of the processes, and a chemist or chemical engineer in the laboratory, who is responsible for the formulas and their working. It is thus seen that a rubber chemist has to be a "factory man," or he will be woefully ignorant of why his formulas are unsuccessful in the plant.

The mechanical man is on the lookout for any all labor saving devices. These usually prove also to be time saving devices. Cooperation with the chemist to shorten the cure saves time but not labor. Oftentimes however, a few minutes saved on a long cure will allow of another heat per day or per shift, resulting in a much better turnover of equipment. Quite often the mechanical man can foresee ways in which material can be saved in factory operations. This is without cutting down on the material actually built into the finished article. For instance, some manufacturers are now curing inner tubes without wrapping them for cure. This not only saves the wraps but also the labor in wrapping and unwrapping. It is significant however, that the stocks, temperature, and time of cure, all have to be changed to meet this new condition. A good many simple mechanical details will result in the production of less "seconds." Even such small items as the manner in which articles are placed in the molds will oftentimes show great difference in percentage of off grade product.

The chemist has a lot of development work to be done at every little change in the factory. Practically every innovation results in the necessitating of a change in one or more formulas. Before going into any detail on how or why formulas are changed, it is well to make a very brief survey of the methods by which a chemist arrives at a proper formula for his goods. He must first bear in mind the all important factor of what service is expected from the product. This determines the cost. Factory arrangements such as time of cure, working conditions, etc., are other items to be considered. Then, having the cost and time of cure very closely determined, he sets about to produce the proper compound. This is done by cut-and-try methods. Small batches are made and cured in the laboratory, each batch being changed from the preceding one. This is carried on until the proper mix is reached. It is here that practical experience comes to the aid of the chemist. None of the compounds are completely figured out beforehand. To be sure, there are many calculations which will enable him to save time in his experimenting, but the resulting formulas are always checked both in the laboratory and in the plant. For example, experience has taught him just how many volumes of each particular pigment are required to give the best results in a tread stock. He has also learned that the use of a certain percentage of reclaim cuts the service a definite degree. He has found out that definite sulfur-accelerator ratios per unit of rubber are necessary for certain lengths of cure, and he has discovered the important characteristics of the accelerators in general use. This has been done either by himself, or the knowledge has been gained by closely following the experiments of others along these lines. It is thus that laboratory research connects directly with factory developments. For if a new accelerator will give a more uniform

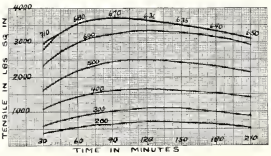


Figure 5.

cure under varying temperature conditions, it can find use in the factory as soon as it is thoroughly tried out.

Preliminary investigations of accelerators are usually made as follows: Using a simple stock, such as would be applicable for inner tube or tire carcass stock, the effect of sulfur variation in the mixture (Fig. 1), and the effect of accelerator variation in the mixture (Fig. 2), is determined. After this information is gained, the most favorable sulfur-accelerator ratio for the purpose in hand is selected and investigated further for the effect of temperature variation on the mixture (Fig. 3), and the effect of compounding ingredients on this ratio (Fig. 4). The obtaining of this data on accelerators in typical stocks, such as tire tread, inner tube, friction or cushion stocks for tire work, and various stocks for mechanical goods, gives a fairly complete summary of the possibilities of any accelerator. As a further requisite, however, all stocks which apparently are satisfactory from their positions in the time-tensile curing curve, are aged both artificially and naturally to determine their life.

The same type of data is obtained when any changes are made in factory formulas. Usually it is not necessarily so complete, the stress-strain data, the tensile-time curing curves, and the aging results being the customary requirements. If for some factory reason the cure is changed, it involves an alteration in the sulfur-accelerator-rubber ratio, and a fairly complete investigation. More often a change is made merely in the quality of the product, necessitating the increase or reduction of the quality of fillers, perhaps replacing the better ones with poorer, or vice versa. Often this does not change the cure on the stock. Occasionally market prices fluctuate to such an extent that shifting the percentages of various ingredients will save considerable in material cost. For example, only a few months ago the spot price on carbon black was up to 30c a pound. Now it can be obtained in any quantity at 10c a pound. Since it is an extremely good ingredient, in fact the best known for giving toughness and wear-resistance to a rubber stock, it is now being used in greater quantities and at an actual reduction in rubber compound cost.

Very often formulas have to be changed to satisfy the demands of the sales department. For, after all, the big thing is to make a product which will sell and stay sold. Usually such alterations are made because of the color of the stock, or because a change is desired from a blooming to a non-blooming stock. The former usually requires little work, the latter a whole new series of formulas.

More often revision of compounds is made to improve factory working conditions. If the stocks are running too dry or too tacky a change must be made in the softener content. If the stocks have too pronounced a tendency to scorch, they must be altered to overcome this condition. This means making a softer stock, rearranging the sulfur-accelerator ratios, or the introduction of a different accelerator. Quite often certain ingredients develop obnoxious fumes, or impart skin rash to workers handling stocks containing them. Either such ingredients must be eliminated, their percentage reduced, or other methods worked out so that the laborer is promptly protected.

The general methods previously given for the development of a rubber stock are directly applicable for investigations of new accelerators. New types of rubbers or compounding ingredients are compared to a known type in a standard formula. Compounding ingredients are investigated particularly for their effect on the stress-strain curve, and the properties they impart to the rubber to help it resist tearing stresses and abrasive wear.

(Concluded on page 32)

TALKING FROM NEW YORK TO LONDON

By

H. W. NICHOLS, '08

ON January 16 the London papers carried prominently headlines such as these:

"NEW YORK ON THE 'PHONE."

"FIRST TALK ACROSS THE ATLANTIC."

"Great Experiment Paves Way to Regular Wireless Telephonic Communication."

"THE GREATEST WIRELESS WONDER."

"U. S. 'Phones to London."

"Voices Heard Perfectly."

"3,200-MILE WIRELESS TELEPHONE."

"New York Talks with London for Two Hours."

"Voices Recognized."

"3,000 MILE COUGH."

"Man in Broadway Chats Like a Neighbor."

"I have sat in London and heard a man cough in New York."

"I have heard a voice say, 'This is 6 minutes past 9,' when by my time it was 6 minutes past 2."

"These wonders, which are miracles in the light of human knowledge a generation ago, took place early yesterday morning in a room at a great new factory at New Southgate, N., where with a number of government and wireless officials I took a seat shortly before 2 a. m."

These newspaper comments followed a demonstration of transatlantic radio telephony given to a group of about sixty prominent Englishmen as an illustration of the possibilities of radio telephony. The demonstration was incidental to a series of tests carried on between this country and England by the American Telephone & Telegraph Company and the Radio Corporation of America.

In 1915 the American Telephone & Telegraph Company had transmitted speeches across the Atlantic and half way across the Pacific, but the speech heard at that time by their observers in Paris and Honolulu was far from commercial. The great advances which have been made since that time in the art of manufacturing high power vacuum tubes and in the development of new telephone methods brought out the desirability of a study of the transmission conditions between America and Europe with a view toward possible commercial operation. Accordingly, a radio telephone transmitting system of the most approved type and capable of sending out about one hundred kilowatts was built by Bell System engineers and installed in the Rocky Point Station of the Radio Corporation of America, in charge of A. A. Oswald, 1915, of the Western Electric Co. Observers with measuring and receiving apparatus were sent to London in charge of the writer to make quantitative measurements of the transmission. These tests began, December 31, 1922 and showed such consistent transmission that it was decided to demonstrate the first predetermined transmission of speech across the Atlantic.

Dr. H. W. Nichols.

In these first transmission tests no telephonic message had been sent but only disconnected words which were used to test the intelligibility of the signals received. It was decided to have Mr. Henry B. Thayer, President of the American Telephone & Telegraph Company, give the first spoken message from New York to London, and great care was taken to transmit no intelligence whatever over the radio circuit until Mr. Thayer was ready to speak. After two weeks of testing a decision was made to transmit this message at 9 p. m. Sunday, January 14, which corresponds to 2 a. m. Monday, January 15, in London. On January 11 invitations were sent out to about sixty prominent English government and radio officials, and the party assembled at the Savoy Hotel late Sunday evening. After some light refreshments, the party was collected in motor cars and taken out to the Western Electric factory at New Southgate, which is six or seven miles north of the center of London. At this place a demonstration room had been arranged with sixty pairs of head receivers in parallel and a complete loud speaking arrangement. The guests were seated at long tables upon which rested the head receivers. After a short introductory talk by Mr. F. Gill, European Chief Engineer of the Western Electric Company, the guests were asked to fit their head receivers preparatory to hearing Mr. Thayer's message which was to come at 2 a. m. sharp. At a few seconds before two o'clock, the circuit to the head receivers was closed and at 2 a. m. everyone in the room heard very clearly and loudly the words, "This is Mr. Thayer of the American Telephone & Telegraph Company speaking from 195 Broadway, New York City, through the Rocky Point Station at the Radio Corporation of America." Mr. Thayer continued for a few minutes and closed by saying, "The clock in my office under the photograph of Mr. Vail is now exactly three minutes past nine." This message was copied in shorthand by ten representatives of the British press who had been invited to the demonstration. These press people also copied more than ninety-five per cent of all the words spoken during the whole demonstration, which lasted about two hours.

Two or three minutes after Mr. Thayer finished his first message, there was received a cablegram from New York confirming this message. This remarkable feat of confirmation, involving transmission and delivery of cablegrams in two minutes, was made possible through the courtesy of the Western Union Telegraph Company which had sent operators to the demonstration room and had extended the Atlantic cable to that point so that for all practical purposes one end of the cable was in the demonstration room and the other was in Mr. Thayer's office in New York. At six minutes after nine Mr. Thayer began to speak again and from then on the talk was almost continuous until four o'clock. Practically no one at the receiving end missed a sentence of any of the speeches and the volume was so great that the room noises—necessarily present when so many people are involved—were entirely submerged. During these talks many of

the listeners sent cablegrams of congratulations to the speakers in New York and these cablegrams were read over the telephone and acknowledged. A few of these messages are quoted:

"CARTY
New York
Representatives of British Press congratulates A. T. & T. Co. and Radio Corporation America in the epoch making experiment the success of which has exceeded their expecta-

Courtesy London Daily Sketch.

Listening in on New York—Sir A. Shirley Benn, M. P. (Chamber of Commerce), Sir Evelyn Murray (Secretary, General Post Office), Senior Guglielmo Marconi.

tions in which they see the dawning of a new era in long distance speaking which will be of the greatest value to the press of the world.
Press Representative."

"CARTY
New York
Heartiest congratulations to the President and Directors of the American Telephone and Telegraph Company for the successful outcome of this evenings experiment the tests of which I have been listening to with the greatest possible interest Please acknowledge and comment.
O. B. Harriman.
Secretary of the American Embassy, London."

"CARTY
New York
President Thayer American Telephone and Telegraph Company New York have just listened to your radio telephonic message which I have heard very distinctly I congratulate you and all those connected with the research which has led to this achievement.
G. Marconi."

About 3:20 the press representatives decided that a transatlantic telephone interview with Mr. Thayer would be of interest and sent the following cablegram:

"Will Mr. Thayer give the first transatlantic interview to British Press what is his opinion on Ku Klux Klan Movement becoming popular in Europe
British Press."

In a few minutes Mr. Thayer read this cablegram and gave the following reply which was received on a loud speaker in the demonstration room, the head telephones being disconnected. This interview was taken down in shorthand by ten people without a single mistake and every one in the room heard it perfectly.

"I have received a cablegram asking my opinion on the Ku Klux Klan movement becoming popular in Europe. As I understand the Ku Klux Klan movement, it is a movement for a more healthy Americanism; but a lawless movement. I hope that Americanism will increase in Europe, but it is my opinion that in these times of unsettlement and unrest the remedy is abiding by laws rather than neglecting them. I believe that no movement which depends on disregard of law will have any long life either in the United States or elsewhere, and that the period when such a movement will have a tendency to extend is coming to a close. I am sorry that the representatives of the British Press chose a subject of which I know so little, but I thank them for the opportunity of saying what I have said. This will terminate the demonstration. I want to take this opportunity to thank you for hearing us so patiently until this late hour. I want to express my best wishes for your health and prosperity at the beginning of this new year, and I hope that at the end of it we shall see the affairs of the earth more settled. Good night."

Those present at the demonstration included Senator Marconi, Sir A. Shirley Benn, M. P. (President, Associated Chambers of Commerce), Sir Evelyn Murray (Secretary, General Post Office), Captain Miles (representing the First Sea Lord), Mr. F. J. Brown (Assistant Secretary, G. P. O.), Group Captain Blandy (Air Ministry), Major T. F. Purves (Engineer-in-chief, G. P. O.), Mr. E. H. Shaughnessy (Staff Engineer, G. P. O.), Mr. S. J. Goddard (General Manager, Western Union Telegraph Company), Mr. O. B. Harriman (First Secretary, United States Embassy), Commander F. G. Loring (Wireless Inspector, G. P. O.), Mr. R. A. Dalzell (Director of Telephones and Telegraphs, G. P. O.), and Mr. W. H. Eccles (City and Guilds Technical College).

Although this demonstration was extremely successful, it formed but a small part of the purpose of these experiments which were undertaken to obtain data necessary for the intelligent engineering of a transatlantic telephone system if that should be demanded. The following brief discussion will give the more important features of such an engineering problem.

In order to design any communication system it is necessary to know what will be the strength of a signal re-received at the receiving station for different amounts of power at the transmitting station, and it is also equally important to know what unavoidable disturbances will be encountered at the receiving station. It is known that for good telephonic communication the received signal must be twenty or thirty times as large as the disturbance under all conditions, and it is therefore necessary to make measurements of both signal and disturbance over a period which in radio telephony must be a full year. When this series of measurements is completed it will be possible to predetermine the amount of power required at the transmitting station to secure reliable telephonic communication at any moment in the year. In radio the situation is somewhat complicated by the fact that both radio transmission and radio disturbances are extremely variable and that, in particular, the difference between summer and winter or day and night transmission is very large.

In order to carry out this investigation, apparatus for the measurement of both signal and disturbance were set up in the permanent location at New Southgate, London, and regular schedules were started and are being maintained between the Rocky Point Station of the Radio Corporation and the receiving station. These tests usually

Courtesy Western Electric News.

An Armour man was in charge at the transmitting station—A. A. Oswald, '15, here shown holding one of the 10,000 watt amplifying tubes.

take the form of transmission of disconnected words beginning every Sunday at 6 a. m. and continuing until the following Monday at 10 a. m., New York time. At the receiving station these words are copied and an estimate made of the intelligibility of the transmission during each period. Steady signals are also sent so that the receiv-

(Concluded on page 32)

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

At the beginning of a new college year the Alumni Section of THE ARMOUR ENGINEER finds itself confronted with greater opportunity and increased responsibility. The Board of Directors of the Alumni Association, at a meeting held October 3, 1923, voted to discontinue the publication of *The Armour Alumnus*. The directors had before them an offer from Mr. H. Ralph Badger, '08, to underwrite the cost of publishing the paper for the coming year, thus insuring the financial outcome. It was felt, however, that the difficulty in securing someone to undertake the editorial work and the problem of obtaining an adequate amount of real alumni news made the prospect of a worth-while publication doubtful. It was accordingly moved and carried that the publication of *The Armour Alumnus* be discontinued.

In view of this action of the alumni association, THE ARMOUR ENGINEER will do everything in its power to maintain an adequate alumni section. We hope to expand this part of the paper considerably, and with the assistance of the individual members of the association, will endeavor to make it of *real interest to all graduates and former students.*

Although it has been decided to drop the publication of *The Armour Alumnus*, there will be no reduction in the other activities of the association. The new officers for the coming year are as follows: President E. H. Freeman, '02; Vice-President, L. A. King, '17; Secretary-Treasurer, R. L. Stevens, '08. The board of managers is composed of the following: H. L. Krum, '06, W. A. Kellner, '10, Ralph Nenfeld, '12, George Fritze, '17, A. A. Hofgren, '18, Jeff Corydon, '22, W. H. Lang, '02, F. M. DeBeers, '05, and W. D. Matthews, '99.

The monthly luncheons which proved such an enjoyable feature of alumni activities last year will be continued this year. The place will be the same, the Hamilton Club, and announcement as to the time will be made in THE ENGINEER, and also by mail to all members of the association.

The first luncheon of the current year was held Tuesday, October 23, 1923, and was attended by forty men, which is an excellent start. The next one will be on Tuesday, November 20, 1923, at the Hamilton Club, at 12:15 P. M. The December luncheon will be on Tuesday, the 18th, same time and place. After January 1, 1924, dates will be decided upon for the remainder of the season.

Ralph Neufeld, 72 W. Washington St., is chairman of the committee having charge of the luncheons. He may be reached by calling Randolph 1584, and will be able to supply any information which may be needed. The committee wishes to urge upon all the alumni the desirability of attending these luncheons. They come only once a month, and you will find that the hour is well worth while.

Harold S. Ellington, class of '08, Dep't of Civil Engineering, has recently announced the opening of the offices of Weston & Ellington, Architects and Engineers, Suite 1507, Stroh Building, Detroit, Michigan. They will conduct a general practice in architecture and engineering in all its branches.

E. H. Freeman, '02.

It will be remembered that Mr. Ellington was active in the organizing of the Detroit Branch of the Armour Alumni Association, the first of such branches to be formed. In connection with his new business venture THE ENGINEER extends congratulations and best wishes for a successful career.

THE ENGINEER believes that the United States Gypsum Company has employed more Armour men than any other concern in the country. The list is as follows:

Mr. M. A. Smith, '10, Director of Education, Chicago.

Joel Pomerene, '14, Sales Engineer, Atlanta, Ga.

Arthur Heeren, '14, Chief Engineer, Fireproofing Department, Chicago.

E. W. Chamberlain, '09, Department Manager, Fireproofing Department, Cleveland, Ohio.

George Fritze, '17, Chief Draftsman, Chicago.

Harold F. Smith, '14, Fireproofing Department, Chicago.

H. E. Jeddy, '14, Sales Engineer, Buffalo, N. Y.

Spencer Havlick, '21, Salesman, Pittsburgh, Pa.

E. M. Seaburg, '22, Sales Engineer, Chicago.

Harry Todtmass, '08 Sales Engineer, Detroit, Mich.

In addition to the above O. A. St. Clair, '05, has been with the Gypsum Co. for several years. He has recently severed this connection, however, and is now chief engineer for the American Cement Plaster Co., Chicago.

EDITOR'S NOTE:—

Men of the class of 1904, as well as other alumni, may be interested to know what some of the other members of this class, in addition to those mentioned by Mr. Wilson, are doing.

Henry Clausen is in the glove business; "Fuzzy" Strang is a hardware merchant; A. W. Jackson is secretary and treasurer of an iron works; C. T. McDonald is president of a fuse and electric specialty company; Bill Borst is in the printing business; Leonard Lundgren is in the United States army.

In a previous issue we mentioned the fact that many of our alumni, particularly those who have been out of college for some time, are no longer following pure engineering but are branching out into various lines of business. Perhaps some have felt that such a tendency is to be regretted, but it has never seemed so to THE ENGINEER. We feel that this is a very natural development, an evidence of growth and increasing capacity in the engineering graduate, and by no means a loss to the engineering profession.

The engineer has not been swallowed up by business, nor his identity lost. He has simply introduced engineering into business, and is transacting it along well recognized engineering lines. As a result of this invasion of business by the engineer, we have an engineer in the cabinet of the president of the United States, engineers at the head of our largest automobile companies, and occupying, in increasing numbers, positions of trust and executive responsibility in countless lines of business.

THE ENGINEER is pleased to present below an article by one of our own "engineers in business," Mr. Gordon Wilson, of the class of 1904.

TECH TRAINING AS A BASIS FOR BUSINESS CAREERS

By

Gordon Wilson
Class '04, A. I. T.

Controller, The National Bank of the Republic, Chicago

Until I returned to Chicago, I had a date for lunch every Tuesday. Each Tuesday, there was a reunion of three members of the class of '04, in a cozy little restaurant on the edge of the financial district of New York, the other two participants being Don Frary and Ed Hiller. Sometimes other delegates from back in the United States would be included in the party.

There always seemed to be plenty of material for gossip regarding the old times and the old bunch. Taking it by and large, '04 gang has done pretty well; but one day, when we dared to take stock, we were shocked to find out how few of them were engineers. Don Frary is Assistant Secretary of an Insurance Company; Ed Hiller deals in watches; I have sunk so far from engineering stand-

ards that I am working with a bank, while Herb Zuckerman has risen to a point where he is now one of the biggest dealers in onions on the Pacific Coast.

For a moment the results of the inventory were a little bit depressing, but we cheered up rapidly when we began to recall just how our engineering training had helped us, in the various lines of work that we were doing. When it came down to brass tacks, every one of us was able to figure out where his engineering studies had made him a better insurance man, watch manufacturer, or banker, as the case might be.

It isn't difficult to figure out a good and logical reason for this. In the first place, a man can't bluff his way through an engineering course. In an Arts course it is often possible to get by with generalities, but in an engineering course a man has to be there with the facts; and what is more, he has to prove that they are facts. A Tech course automatically weeds out the loafers. A Tech man gets the best experience and training in solving problems.

In the course of my business experience, I have seen a great many young men fail to make the most of their opportunities, simply because they were unable to reason out the solution of some problem with which they were confronted. As long as they had someone above them, to do their heavy thinking, they were good and competent employees; but when they had to do their own thinking, they stopped. They had become skillful in certain mechanical motions, both physical and mental, but they had never mastered the principles which underlay what they were doing, and had never tried to apply those principles to their work. Some of them have declined more responsible and better paid positions, because they frankly admitted their weakness in this respect. This is the type of man who never can have a future, because the future, like every other structure, must have a foundation and the foundation is not there.

THE ARMOUR ENGINEER offers a prize of an "A" in Industrial Chemistry to the student who guesses the weight of John Schommer's largest fish.

One of the best accountants who ever worked for me was an electrical engineer, a chap from Stevens Tech. When I hired him, he did not know the difference between a ledger and a checkbook; but I did not have much difficulty in getting him to grasp the fundamentals of accounting. I was engaged, at that time, in reorganizing the accounting department of an automobile company; and one of our jobs was to put in a cost system that analyzed the labor cost of a chassis into about forty-five thousand different items. My engineer went in as chief cost clerk. We tackled the problem from an engineering point of view, determined the analyses that should be made, worked out our methods of getting better labor and material costs, and before very long he was the head of a cost department that was functioning with perfect smoothness, and handling a job that would have driven many a professionally trained accountant to drink.

I am convinced, therefore, that a tech school is the best possible school for the chap who has made up his mind that he is going to succeed, whether he has decided to make engineering his life work or not. No prize fighter ever made a success in the ring by doing his training around a checker board, and if a business man is going to train for the hard knocks, the concentrated plugging, and the quick, correct, properly based decisions, that are essential to business success, the best place for him to train is where such things are demanded in the course of his regular scholastic work.

Fraternity activities at the Institute are a much more important feature of Armour Tech social life than they were when many of the earlier graduates were students. THE ENGINEER believes that such activities are an important and valuable part of student life, and should be encouraged. It is with much satisfaction, therefore, that we announce that the Armour Chapter of Theta Xi has purchased the house at 3305 Michigan Ave. for a fraternity home. The purchase was made by the alumni association of the local chapter. The house was built by Mr. Kuppenheimer, a name well-known in business circles in Chicago. Later it was purchased by the prominent surgeon, Dr. Murphy, from whose estate it was purchased by the fraternity. It is a three-story, sandstone structure, well built, conveniently located near the Institute and admirably suited to the needs of a fraternity chapter.

We congratulate Theta Xi upon this important step, and hope that they will find their new home a source of much pleasure and satisfaction. We hope further that this step is but the beginning of a new development in fraternity life at

New T. X. House at 3305 Michigan Boulevard.

Armour, and that the new owners will soon be followed by others in the "Own Your House" movement.

The 26th of May, 1923, went down as a red letter day to some three dozen students of A. I. T. On that day the local fraternity previously known as Scroll and Triangle became Armour Chapter of the Triangle Fraternity.

Triangle is a professional engineering fraternity and was organized at the University of Illinois in the year 1907 by a group of Civil Engineering students. It remained a local club there for two years and then upon affiliation with a similar organization at Purdue began its national expansion. It was soon realized that wide expansion could not take place while restricting membership to Civil Engineering students so the policy was changed to admit students of all the various branches of Engineering. There are now nine active chapters at the following institutions:

Illinois
Purdue
Ohio State
Wisconsin
Kentucky
Cincinnati
Iowa
Minnesota
Armour

There are now approximately 900 alumni of Triangle, not a large number, but of considerable effect when it is recalled that all are in the same field of endeavor, viz., Engineering. The local Chapter now has 14 alumni from its two graduating classes.

As a local fraternity last year, the organization rented the house at 3305 Michigan, but during the first week of this semester moved across the boulevard to 3322, occupying one-half or eighteen

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EDITORIALS

"THAT'S GOOD—GO ON"

Mark Twain writes in his humorous style, of the last words of great men. Almost without exception, he says, these phrases are incoherent, meaningless, and completely void of any thought typical of the man or his greatness. We are unprepared to doubt the authenticity of this general rule, whether formulated in jest or earnest, but unusually impressed by an outstanding exception; the last words of our late President, Warren Gamaliel Harding:

"That's good—Go on."

To us it is a challenge and an inspiration— a challenge to the man—an inspiration to the engineer. Embodied in these four words are the prime essentials of the engineer. A profession which always has, and always will lead its sons into the unknown, and the hazardous, the darkness, and the light, can be manned only by those whose intent of purpose recognizes no unsurmountable obstacles. In the front line trenches of progress, the engineer must both hold the captured territory and constantly advance into the new. To stand still is impossible.

It's a big job. Do we measure up to it? That we are here is proof that we have, at least in part, subscribed to the doctrine of advancement. One thing remains:

Go on, and on, and on.

THE COOLEY PRIZE ESSAY COMPETITION

Through the generosity of Dean Mortimer E. Cooley of the University of Michigan, a prize of one hundred dollars is offered to the students of the Armour Institute of Technology for the best essay discussing the following topic:

"Old Civilization and Our Own"

Dean Cooley suggests in his letter of gift that each contestant bring out clearly corresponding phases in all civilizations (including our own) and what (if anything) our civilization has that the older civilizations did not have, and which if properly availed of will enable us to avoid the disasters which befell the old.

A second phase of the paper would be the means to be employed to bring about the prolongation of our civilization—the practical means.

A discussion of how these advantages may be preserved, with special reference to the part the engineer has had in the building and development of ancient and modern civilization, would be included.

The printed conditions of the contest may be obtained at the office of the President.

Each student should take an active interest in this contest. Not only has he an opportunity to win an entirely worth while prize, but the general information and erudition obtainable from the necessary preliminary reading and investigation will be its own reward.

Advice to prospective entrants of the contest, together with suggestions of desirable books to read in preparation, may be obtained from members of the Committee of Award.

WILLIAM HENRY MERRILL

With the demise of W. H. Merrill, Founder, and President of Underwriters' Laboratories, an interesting episode connecting the life of this remarkable man with the history of Armour Institute of Technology is brought to light.

In 1903, while Underwriters' Laboratories was still more or less in its infancy, President Merrill found considerable difficulty in securing the services of the kind of technically trained men he needed. With the remarkable foresight which characterized the man, Mr. Merrill conceived the idea of a course in Fire Protection Engineering. Nothing of this sort had ever been dreamed of before, but with this idea in mind he held several conferences with Doctor Gunsaulus, then President of the A. I. T. in which he offered to donate the use of the necessary equipment and the time of several of Laboratories' best engineers toward the furtherance of the plan. The final result was the founding of the only Fire Protection Engineering course in the United States. Throughout his life he continued to foster and aid our four year Fire Protection Engineering Course in every possible manner, and he continued to be identified with the movement until his death, at which time he also was a member of the Fire Insurance Scholarship Committee.

Mr. Merrill was a graduate of Massachusetts Institute of Technology of the class of '89. He was a member of Sigma Chi, the Mid-day and University Clubs of Chicago, and an honorary member of the Underwriters' Association of the Northwest, and of the National Fire Protection Association.

E. C. M. A.

The "Engineering College Magazines Associated" is a group of college engineering publications, the avowed purposes of which are: Adequate representation in soliciting national advertising; the elimination of multiple discounts to agencies; standardization of size of type page; improvement in editorial quality; and improvement in general make up and appearance.

The present members of this association are:

The Colorado Engineer
The Cornell Civil Engineer
The Iowa Engineer
The Kansas Engineer
The Kansas State Engineer
The Michigan Technic
The Minnesota Techno-Log
The Nebraska Blue Print
The Ohio State Engineer
The Penn State Engineer
The Princeton News-Letter
The Rose Technic
The Sibley Journal
The Technograph (U. of Ill.)
The Tech Engineering News (M. I. T.)
The Towne Scientific Journal (U. of Pa.)
The Transit (Iowa U.)
The Virginia Journal
The Wisconsin Engineer

Of this organization THE ARMOUR ENGINEER is now a "probationary member." That is, if at the time of the convention, which will be held sometime during the coming winter, we are found to have complied with the "Standards of Practice," which is the particularized working contract derived from above listed purposes, THE ARMOUR ENGINEER will be admitted to full membership. These standards are the result of the best editorial and advertising practice in the type of publication concerned. They are thoroughly practical and readily applied. It is therefore, we hope, more or less of a matter of time until THE ENGINEER will become a full fledged member of the E. C. M. A.

(Continued on page 33)

COLLEGE NOTES

President Raymond represented Armour Institute of Technology at the inauguration of Dr. Samuel S. Stratton as President of Massachusetts Institute of Technology.

Dean Monin was present at the dedication of a bronze tablet commemorating the fallen war heroes of the Art Institute. Professor Reed was chairman of the presentation committee.

Professor Gebhardt attended the Convention of the Society for the Promotion of Engineering Education at Cornell University, Ithaca, New York.

Professor C. B. Cooper has recently completed a contribution to the Manly Anniversary Studies in Language and Literature, entitled, "The Ideas of Captain Thomas Morris."

Dr. Alderson of the Colorado School of Mines spent the week end of September 23 in Chicago. Dr. Alderson, who was Dean of the Armour Institute of Technology from 1893 to 1904, acted as chairman of the Oil Shale Division of the recent American Mining Congress held in Milwaukee.

J. A. Brewster, formerly of the faculty of Armour Institute of Technology, is now Assistant Professor in the Department of Mathematics of the College of the City of New York.

Armour Tech is certainly a growing institution—witness, the following additions to the faculty.

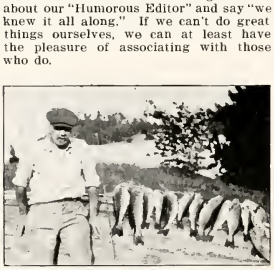
Mr. A. W. Anderson, instructor in Descriptive Geometry and Machine Drawing, is a graduate of Worcester Polytech, class of 1922. Mr. Anderson is a golf and tennis fan.

Mr. Walter Hendricks, Instructor in English, is a graduate of Amherst, '17. During the war he served in the air service as a flying instructor at Chanute Field and as an American "Ace" in France. Mr. Hendricks previously taught English at Carnegie Institute of Technology.

Mr. E. E. Tupes, lecturer in Business Law, is a graduate of the University of Missouri, class '09, and Kent College of Law, class '18. Mr. Tupes is an active lawyer, specializing in patent and trademark law.

Another addition to our worthy faculty comes to us in the person of Henry Penn, Assistant Professor of Civil Engineering. Professor Penn has had an enviable athletic record at the University of Illinois as a member of the freshman varsity baseball team in 1907 and of the varsity teams in 1908, 1909, and 1910. He was awarded two letters. It is whispered that he is to be our new baseball coach.

Claude A. Stiehl's latest play, "The Man in the Garret" is being produced by the Ypsilanti Players of Ypsilanti, Michigan. This organization is one of the largest, best known, and best equipped amateur theatrical groups in the country. Here we feel inclined to brag a little about our "Humorous Editor" and say "we knew it all along." If we can't do great things ourselves, we can at least have the pleasure of associating with those who do.



Prof. G. M. Wilcox is a disciple of both Issac Newton and Walton. We wonder if these were caught by means in accordance with the latest theories and formulae on the subject.

Armour Tech is greatly indebted to Mr. Granville Jones who addressed us on October 5. He formulated, convincingly and with utmost sincerity, his philosophy of life. It is rarely that the guiding flame of a man's life has been so clearly revealed.

In the final competition for the 16th Paris prize, the subject of which was "An Office and Reception Building, for the President of the United States," H. K. Bieg placed second, and I. J. Loebl placed third.

Miss Elizabeth Kimball and Mr. Rudolph J. Nedved were recently married in London. Both are former students of architecture at the Armour Institute of Technology.

Our hearty congratulations are extended to E. N. Harsha, who on August 19th married Miss Hilda Warner. It is to be hoped his example will encourage any other seniors who are anxiously waiting to "pop" the question.

The good ship "Class of 1924" will be piloted on its final voyage by the following officers:

President.....E. O. Pierce
Vice-President.....C. A. Stiehl
Treasurer.....R. M. Beckwith
Secretary.....D. E. Richardson
Sergeant at Arms.....E. J. Terry
Social Chairman.....E. A. Barrett

They will be assisted by the chairman of the class committees.

Pictures.....F. H. Blumenthal
Jewelry.....E. A. Sisson
Program.....S. L. Chaney
Cap and Gown.....A. T. Waterman
Auxiliary.....E. R. Sanborn

The Junior Informal

As THE ARMOUR ENGINEER goes to press, complete information regarding the Junior Informal Dance is not available. However, indications point to a very successful affair. For the benefit of the new members of Armour Tech a few words will be said regarding class dances in general.

These dances are not restricted to a particular class. They may be regarded as family affairs in which all school members and their friends may participate. Considering the small enrollment of A. I. T. it is imperative that the entire student body support the individual class events. In an engineering institution of this kind, where the curriculum of necessity must be severe, such an event comes as a refreshing oasis in the desert of study.

The Junior Informal will be held at the Hotel La Salle in the beautiful Louis XVI room on November 16. The best way to make your class dance a success is to support the dances of the other classes.

Sophomore Dance

The Sophomore dance will be given at the Opera Club, 18 W. Walton Place, December 14. Music will be furnished by seven of Benson's Best Collegians. Everybody attending is assured of a good time.

The Sophomores adjourned to The Mission to hold their class election. This wise forethought guaranteed good acoustics for campaign speeches. The men entrusted with the class affairs were:

President.....J. Hogan
Vice-President.....A. J. Danziger
Treasurer.....E. A. Marhoefer
Secretary.....S. J. McLaren
Sergeant at Arms.....R. H. Davis
Social Chairman.....T. J. O'Malley

A Reserve ordinance unit is in process of formation at Armour Institute of Technology. The unit will be known as the 108th Ordinance Company, 33rd Division. It will consist of about forty men, two lieutenants, and the requisite number of non-commissioned officers. The equipment will include a complete mechanical and repair outfit with truck, an official Cadillac car, a motorcycle, and mounts for two polo teams.

Through the efforts of the Radio Club, A. I. T. was enabled to "Listen in" on Lloyd George at his Chamber of Commerce speech.

The Junior Class election was a regular get-together party, for all third year men were present. As a result of this unusually good attendance a very spirited contest took place in which the following men were elected.

President.....W. H. Weinwurm
Vice-President.....C. J. Plocar
Treasurer.....E. W. Odenwaldt
Secretary.....U. C. Kramer
Sergeant at Arms.....H. H. Geymer
Social Chairman.....E. S. Larson
Junior Marshall.....E. R. Hubbell

(Continued on page 34)

ABSTRACTS

The ZR1

The sight of the ZR1 as she leisurely cruised over the city of Chicago recently has caused much comment. This is the first time in the history of aviation that a rigid airship has been inflated with the non-inflammable gas, helium. The use of helium eliminates the fire hazard which accompanies the use of hydrogen.

The first trial flight of this craft was made at the Naval Air Station at Lakehurst, N. J., and was of about one hour's duration. This flight was merely straight-away flying, no attempt at altitude or speed being made. The speed was under thirty-five miles an hour at all times and the altitude at no time exceeded eleven hundred feet. This flight proved that the enormous ship handles readily at low speeds. This is one of the most important features of rigid airship performance.

That the construction of the ship was all that could be desired was evidenced by the fact that there was not even a creak in the duralumin framework forming the skeleton of the ship. Duralumin, by the way, is an alloy of copper and aluminum and combines lightness with amazing strength. A ten foot length of this alloy is so light that it may be easily lifted on a man's little finger yet it will, if supported on its ends, carry the weight of all the men who can find room to sit on it.

The design of this leviathan of the air is primarily American although modeled after the most successful German Zeppelins. The factor of safety in the ZR1 is much higher than in any other rigid ship built. The designers, while admitting their debt to the Germans, point out numerous changes and improvements made which seem sound enough and extensive enough to justify the statement that the United States may walk alone in the construction of such craft.

Although this craft was primarily designed as a long distance eye for the navy, its use in peace times as a safe and rapid means of transportation should not be underestimated.

New Process for the Solution of Ebonite

The E. H. Clapp Company has patented an interesting process for dissolving ebonite. The solvents are recovered as by-products from the acid treatment of terpene containing materials.

Substances, such as oil or spirits of turpentine, are thoroughly mixed with commercial hydrated crystalline oxalic, about 2.15% to 10% by weight, and the mixture is digested at atmospheric pressure or above at a temperature around one hundred and fifty degrees Centigrade. The mixture is allowed to cool until the oxalic acid separates out. The acid and product are separated and the acid completely removed by further washing. The product is subjected to fractional distillation to remove those oils with boiling point below two hundred and two degrees Centigrade. The heavy oil residuum obtained is a solvent of ebonite and hard vulcanized rubber.

Heavier distillates also possess the property of dissolving hard rubber. The ebonite solution is obtained by stirring into the solvent finely ground ebonite. On exposure to heat the mass solidifies to a rigidity possessed by the original ebonite.

Sibley Journal of Engineering.

Water Power at Niagara Falls

Niagara Falls, the greatest single source of water power in the United States, will transform more of its great power into electrical energy through the two largest generators ever made. These generators, being made by the General Electric Company to be installed on the American side of the great falls, will each produce 87,000 horsepower, or energy equivalent to the muscle power of 375,000 men.

Each generator will weigh 700 tons, will stand 35 feet high, and will have a diameter of 35 feet.

This is another step in the further development of the water power resources of New York State. It is estimated that the total undeveloped horsepower of the water power resources of that State is 4.2 million as compared to 1.3 million total horsepower now developed.

The 4.2 million horsepower of undeveloped water power in New York State, if developed, would save over 40 million tons of coal, or more than enough to operate all industries, public utilities, and railroads, so that coal would need to be used for domestic heating only.

In addition, this saving would release for other uses 500 locomotives and 15,000 coal cars now continuously in use to carry this coal; and over 400 million dollars in railway equipment.

The lower cost of hydraulic power would save about 140 million dollars annually, besides making industrial cities and towns clean and smokeless, one famous authority declares.

G. E. College News Release.

An Unusual New Metal

The Ashcroft Company of New York City is announcing a new casting metal called MMM. This metal is an outgrowth of the company's original application of Monel metal as a material for making seats and disks for various valves.

Because of the severe requirements which these parts of their equipment met, this company conducted a research to find a modification of Monel that would be useful in casting where high temperature and pressure were met and when subjected to corrosion.

The metal developed by this company and which is now being placed on the market is made from Monel as a base. To this are added proper proportions of other elements, and the result is a casting metal for which numerous claims are made. It is resistive to the action of high pressure superheated steam. It is non-corrosive in contact with hot oils and most chemicals such as sulphuric acid and dye baths. Its physical properties at high temperature are unusual. At normal temperature the tensile strength of this metal is given as approximately 70,000 pounds per square inch. It is said to retain more than three fourths of this value at 900 degrees F.

This metal can be used for any type of casting, small or large. It flows freely into very thin sections, giving sharply defined edges and smooth surfaces. The makers announce that by slight variations in the make-up of the alloy they are able to vary its properties to meet the needs of individual consumers. The metal is particularly well adapted to use in chemical industries, there being only a few substances with which it will not give results as a non-corrosive.

Instrument for Recording Carbon Monoxide Concentration

An instrument for recording continuously the carbon monoxide concentration up to ten parts in ten thousand is being devised by the Pittsburgh station of the United States Bureau of Mines. When set up, the instrument will be calibrated with known mixtures of carbon dioxide in air. If the instrument proves practicable, it should be found useful around blast furnaces, metallurgical, chemical plants and other places where a carbon monoxide hazard exists.

Foundry.

Roller Bearings for Railway Cars

Roller bearings, although by no means new, have a new application in their latest use, that of bearings for railway cars. Such a bearing as will take care of the excessive loads encountered in such work is now undergoing tests on one of our most prominent railways. The bearing has held up in a satisfactory condition after eighteen months of service. Ordinarily such a test would be considered fairly conclusive but for railroad service extremely conservative criteria are necessary. Such a bearing if practicable means an enormous saving in fuel efficiency and the cost of moving freight.

The unique bearing, which is made by a New York manufacturer, is self aligning by reason of its outer race, which is ground spherical on its inner surface. The rollers are barrel shaped with their largest diameters toward the inner ends. This permits of great freedom of movement between the inner and outer rings which are always concentric on their bearing surfaces.

Scientific American.

Self-Lubricating Gasoline

According to the Engineering World of March 23, a self lubricating gasoline has been developed in California which

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SOCIETIES

ARMOUR TECH ATHLETIC ASSOCIATION

The organization of the association has been completed for the coming year and the various branches are rounding out their plans for a most successful term.

The officers and committee are as follows:

President.....E. E. McLaren
1st Vice-President.....C. J. Plocar
2nd Vice-President.....J. V. Hogan
Secretary.....J. S. Greenleaf
Treasurer.....G. S. Allison
Chairman of Social Committee.....M. H. Cooper
Chairman of Publicity Committee.....E. R. Hubbell
Chairman of Reception Committee.....E. J. Harrington
Inter-Class Athletic Manager.....G. P. Ruddiman
Inter-Fraternity Athletic Manager.....L. C. Thoelecke

The value of the work done by the Athletic Association in co-ordinating the various efforts to boost Armour Tech was demonstrated last year. To carry on the good work and to develop into a more useful organ is the plan for this year.

Treasurer's Report, College Year 1922-23.

Receipts

724 students' fees, $7.50 each, 1st Semester	$5,430.00		
Less refund (student did not attend classes)	7.50	$5,422.50	
662 students' fees, $7.50 each, 2nd Semester	4,965.00		
Less refund (student deceased)	7.50	4,957.50	
Song and Cheer Contest			
Class and other donations	421.00		
Less printing and prizes	353.21	67.79	
Interest (funds on deposit)		64.26	$10,512.05

EXPENSES

Basketball		310.64	
Boxing and Wrestling		42.84	
Cycle	3,437.70		
Advertisements, class and other donations, and cash sale of books	1,284.79	2,152.91	
Directors and Coaches		3,444.00	
Armour Engineer	2,008.49		
Advertisements, Alumni and Faculty subscriptions	994.78	1,013.71	
General Expense	250.37		
Duplicate ticket fees	1.50	248.87	
Golf	65.23		
Balls Sold	6.60	58.63	
Musical Clubs	1,159.09		
Concerts, Home Concert and advertisements	907.50	251.59	
Tennis, including building 4 courts and fences	2,132.72		
Donations	50.00	2,082.72	
Track	620.47		
Refunds from meets	90.50	529.97	
		10,135.88	
Cash balance		376.17	$10,512.05

WESTERN SOCIETY OF ENGINEERS

The W. S. E. has started the year with a burst of pep. The first meeting, the "Get-Together" meeting, was addressed by Professors Phillips and Wells. The speaker at the next meeting was Mr. E. H. Olson, who spoke on "Water Supply for Railroads." On Oct. 18, Mr. F. E. Morrow, Chief Engineer, C. & W. I. R. R. spoke on "The Problems of the Railroad Engineer." These last two talks served to give us a good conception of Railroad Engineering.

There will be a smoker in the near future, but it is too early to give details now.

The Constitution and By-Laws have been amended in order to broaden the field of the W. S. E. All Civils are now eligible to membership, and all can vote. All the benefits and pleasures of the W. S. E. are now open to lower classmen as well as upper classmen. Students in other Departments are cordially invited to attend the meetings.

The officers for this year are:

President.....H. C. Friedman
Vice-President.....H. J. Van Dyke
Secretary.....J. S. Sweeney
Recording Secretary.....R. Rasmussen
Treasurer.....W. B. Douglas

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The Armour branch of this society had its first meeting on October 4. The meeting was entirely devoted to the election of officers for the ensuing year.

The officers are:

President.....J. R. Brady
Vice-President.....M. F. Adair
Treasurer.....F. J. Nerney
Secretary.....J. G. Johnson

On October 18 a very interesting talk on "Gasoline, Its Process of Development and Future Possibilities," was given by Professor Harry McCormack.

If attendance and interest in the meetings is any omen the society feels that this will be one of its most successful years.

FIRE PROTECTION ENGINEERING SOCIETY

President.....K. E. Eppich
Vice-President.....A. T. Waterman
Secretary.....R. B. Grove
Treasurer.....E. F. Reschke

As provided by the constitution, the above named men were elected to office at the first Fall meeting by the Senior and Junior members of the society. At this meeting also, a discussion took place regarding the desirability of amending the constitution so that elections might take place in the Spring, and all members might be permitted to vote at the election. This matter was handed to a committee and will be acted upon later.

It was proposed in this meeting that the society obtain pins similar to those worn by several of the other student engineering societies as identification of membership. Most of the discussion on this matter was unfavorable, but favorable toward some sort of membership identification. In this respect it was recommended that the society adopt the "shingle," or engraved certificate of membership, more or less historic among the student engineering societies in the older colleges.

The arrangements for an F. P. E. S. smoker, with an indefinite date set for about Thanksgiving time, were turned over to a committee.

ARMOUR TECH MUSICAL CLUBS

In the fall of 1922, on the formation of the Athletic Association, the old "Armour Tech Musical Clubs" became a part of that organization and are now among the most active of its members.

Professor H. R. Phalen is directing both the Glee Club and the Orchestra. Practice was begun immediately following the opening of the school year and both organizations have since acquired a goodly repertoire. One concert has already been given by the Glee Club, at the Ravenswood Methodist Episcopal Church. The appearance in chapel has also been twice noted. This organization has two very capable men in the persons of M. W. Westerberg, student leader, and A. R. Waehner, accompanist.

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FRATERNITIES

TAU BETA PI

The fall election of candidates to Tau Beta Pi occurred on the evening of October 12, at the fraternity's rooms. At this election the eligible list consisted of the names of the highest one quarter of the Senior Class, and the Junior honor man.

Due to the exceptional size of the Senior Class and the correspondingly large list of eligibles, unusual care was found necessary in the process of elimination. Never before has Beta Chapter of Illinois, founded in 1906, been confronted by such a large list of eligible and worthy candidates.

The results of this elimination will be published in the January issue of THE ARMOUR ENGINEER.

Among other important business considered at this meeting, Dean M. E. Cooley's generous prize offer was discussed and the Chapter's support pledged to the contest.

At the previous meeting Brother R. M. Beckwith was elected to represent Beta Chapter at the annual national convention, which is being held at Lexington, Ky., Kentucky Alpha, University of Kentucky, being the hosts.

Beta Chapter's officers are:

President.....J. H. Sweeney
Vice President.....R. M. Beckwith
Corresponding Secretary..T. E. McDowell
Recording Secretary.....R. Rasmussen
Treasurer.....C. F. Kautz
Associate Editor of "The Bent".....E. O. Pierce

SALAMANDER

The principal business of the last regular meeting of Salamander for the school year 1922-23 consisted of the election of its present officers: However, the actual turning over of the duties of the society and its officers to the present members occurred at the spring luncheon at the Great Northern Hotel.

This year Salamander plans to make an exceedingly active one. Plans are already on foot for keeping in intimate touch with all alumni members through the medium of a semi-annual chapter news-letter.

Fall election results are not yet complete, but will be available for publication in the next issue.

SPHINX

At the last spring meeting of The Sphinx the following men were initiated:

C. A. Stiehl
Cycle Editor, 1923
G. P. Rudolman
Cycle Business Mgr., 1923

With the new importance and value achieved by the Armour Tech publica-

(Continued on page 28)

ETA KAPPA NU

The activities of Delta Chapter are well under way again, and this promises to be a very successful year.

We wish to announce at this time the election of the following men to Eta Kappa Nu:

C. J. Buck
C. L. Keene
C. S. Shaffer
H. H. Chun
C. E. Larkin
E. M. Meyer
W. J. Patterson
A. S. Stemwedel

PHI LAMBDA UPSILON

Greetings, You Freshmen Chemicals!

You have embarked upon a four year voyage, bound for the port of Chemical Engineers; and a goodly port it is for those who attain it. Be not afraid, nor yet too self confident for the going will test the seamanship of the best among you.

Start now, and in earnest, if you would enter port with colors flying, and be convinced that the reward is worth the effort.

To those who excel in scholarship and possess those personal attributes that say "man," there will appear beacon lights on the way. At the beginning of your Sophomore year, that man among you who has attained the highest average during his Freshman year, will receive the annual Phi Lambda Upsilon prize. During your Junior and Senior years, some of you, by virtue of your past efforts will become eligible to membership in Phi Lambda Upsilon, the national honorary chemical fraternity. And should you need a pilot in the meantime, look for the man with the key, and you will find a friend.

Activities for the year started early for Omicron Chapter. Preparation for the National Convention, held in Milwaukee on September 14-15, brought the members together at the opening of school Brother F. H. Blumenthal was the delegate to the convention from Omicron chapter.

The first pledging of the year took place on Tuesday evening, October 16; the following men being invested with the blue and red ribbon.

SENIORS
C. A. Rietz
K. Steiner
HONOR JUNIOR
M. F. Adair

The officers for the current school year are:

President.....E. W. Husemann
Vice-President.....J. R. Brady
Secretary.....C. F. Kautz
Treasurer.....F. H. Blumenthal

SCARAB

Faithful Scarabs pilgrimaged to the Rogers Park Hotel on the evening of October 24, to attend the first banquet of the school year and to witness the initiation of four new men: Harold Reynolds, Eugene Voita, Willis McCauley, and Lionel Senescall. These men presented as their theses, designs for "A Scarab Ceremonial Hall."

Mr. Zettler and Mr. Louis Sullivan were speakers, and the attendance of many of the alumni added to the enjoyment of the evening.

CHI EPSILON

The first meeting of the year was held on October 1, with seven Senior Civils answering roll-call. The policy and program for the year were discussed and among other things it was decided to hold two meetings of a purely literary character each semester. The list of men eligible to election this semester was read.

At the next meeting, the following men were elected to membership.

H. C. Friedman
E. Niederhofer
L. Proehl
A. J. Zelenka

Chi Epsilon is a National Honorary Civil-Engineering Fraternity. Its object is to fittingly honor the civil engineering students who through their achievements at school, deserve recognition. Its members are elected from the Junior and Senior classes and must have maintained an average in the upper one-quarter of the class. Other important requisites for membership are: Sociability and Practicability.

We are glad to announce that a charter for a chapter of Chi Epsilon has recently been granted to the University of Southern California.

Due to the crowded conditions at the Institute our meetings are being held in the Tau Beta Pi rooms.

PHI KAPPA SIGMA

The Alpha Epsilon chapter of Phi Kappa Sigma has entered upon the school year with twenty-three active brothers, each of whom is actively engaged in school duties and activities.

Rushing season this year was of two weeks duration and the efforts of the boys have been rewarded by the addition of seven pledges of exceptional calibre.

The social calendar for the current year has included a smoker at the house, a smoker at the Phi Kappa Sigma Club of Chicago, and a house dance. The Founders' Day Banquet held at the Ambassador Hotel will be attended *en masse*, and the Phi Kap Football Dance following the Chicago-Purdue and Illinois Northwestern games promises to be one of the bright spots of the season.

SPHINX

(Continued from page 27)

tions The Sphinx has been felt to have in a measure outgrown its former character. On this account a number of important and far-reaching changes are planned, principally in the direction of an increase in membership and an increase in activity. The constitution is being revised and in the next issue it is hoped to be able to announce the initiation of a number of candidates, together with the news of activities along new and interesting lines.

President.....E. O. PIERCE
Sec'y-Treas.....G. P. RUDDIMAN

THETA XI

Alpha Gamma of Theta Xi moved into her new home on September 15, as scheduled, and since that has necessarily spent her greatest efforts in re-conditioning the house. To do this in full measure takes months rather than weeks of work, but the possibilities are unlimited and ownership is proving itself to be an unparalleled, as well as worthy, incentive to do things.

The Informal Dance held on October 12 was attended by 96 followers of the Goddess Terpsichore, and at our Annual Holloween Hop on October 27, fun and frolic aplenty were provided for no less than 80 happy, care free couples. As it was the day of the Purdue-Chicago game, activities and Alumni from the Hoosier University chapter were much in evidence. Confetti, serpentines, fuzzy woozy spiders, and "spooks" helped to make it "the best ever."

December 8 has been set as the date of our House Warming and Annual Chapter Homecoming. The inquiries that have come in already indicate a record attendance of Theta Xi honoraries and of the Old Guard of Omega Lambda.

The "I Will" spirit of Chicago seems to have been applied matrimonially by a number of our men during the past summer. Brothers Matson, Chase, Stoker, Hauth, Pope, Marx, and DeCelle, are now "at home."

Theta Xi announces the pledging of the following men: R. M. Beckwith, LeR. F. Eckhardt, E. B. Hatch, Jr., Chester Long, W. F. Meyers, C. N. Mullican, Jr., F. T. Munch, O. P. Robinson, G. A. Soule Jr., G. O. Vandeveer.

An interesting situation is to be found in the house since pledging, in that fourteen different states are now represented, including New Jersey, Washington, and Louisiana, as well as Ontario, Canada.

Brother R. O. Matson has taken up his duties at the Underwriters' Laboratory as an instructor in the Fire Protection Engineering Department.

SIGMA ALPHA MU

After a summer of work, interspersed with a few hikes and smokers, Sigma Alpha Mu is back full of determination to maintain her high scholastic standing.

The chapter opened its social season with a smoker on Wednesday, October 3, at the Morrison Hotel. The affair proved to be a real reunion as most of our chapter alumni were present.

Our first big affair of the season will be a masquerade supper-dance to be held on Thanksgiving night at the Opera Club.

Graduation took a heavy toll; Brothers Goldstein, Sang, Pollan, Rotberg, Stangle, Tilds, and Herman, having graduated.

Our pledges are: Buchsbaum, Ritman, and Cohn.

SIGMA KAPPA DELTA

The first "real" event of the Sigma Kap's social season was a house dance on October 5. However, the monotony of the first weeks was successfully broken by several stag and theatre parties. On the thirteenth of October we enjoyed ourselves at a smoker at which several of our alumni were present.

"Jake" Keith, chief engineer of the Kansas City Light and Power Company was in the city for a few days. A. R. Edwards will shortly be located in Erie, Pennsylvania, with the United States Gypsum Company. Incidently "Al" was recently married to Miss Alice R. Hopkins.

DELTA TAU DELTA

The opening of the present year found us with twenty-one actives and four pledges back, consequently we were off to a good start, and with the addition of nine "good and true" freshmen pledged on October 15, we are expecting great things of the future. Professor Carpenter of Beta chapter has been appointed faculty adviser to the chapter and under his guidance the pathway should be somewhat smoother.

Recent returns from the front show that Brother Cox has a very good position with the Michigan Inspection Bureau. More power to you O. L. Brother Bob McGuire has just returned from his perambulations of Europe *a la* bicycle.

Several of the brothers have been very active in rushing this season among them being Wignall, Wells, Woods, Bradley, Brinkman, and Erickson. Many thanks, boys.

BETA PHI

Beta Phi entered upon the new college year with marked enthusiasm. About thirty of our men have returned to school. Among the events included in our social calendar to date are a smoker held on Friday evening, October 5, and a party and dance for "rushees" held October 23. The smoker was voted a huge success as the entertainment was very good. Aside from the smokes, music, and refreshments the evening was featured by "Bob" Gaylord's "Houdini" stunt. His crystal gazing and futuristic predictions were much enjoyed. Mr. Miller then both entertained and instructed us with his gymnastic exhibition on "How to keep fit." The music for the dance was furnished by Benson's Collegians and was thoroughly enjoyed by the forty or more couples in attendance. We were all sorry to have twelve o'clock come around, and are looking forward to another party just as successful.

RHO DELTA RHO

Our annual "Welcome Home" held on September 9 found us once more assembled and ready to "carry on." We found ourselves in good condition for the long grind, and though it may seem strange, glad to get back to school.

Under the stimulus of the new blood which has entered our ranks, we have planned an extensive social calendar, which will in no way interfere with the high scholastic standing which we intend to maintain.

The rushing period was marked by a smoker; and a rushing party was held on the last night of the rushing period.

As this goes to press, plans are under way for a Halloween party, which promises to give the cats and witches competition in Halloween pranks.

With everyone on his toes, we feel that we are facing one of the most successful years of our existence.

TRIANGLE

The house was kept lively throughout the summer months by an average of about nine brothers who made it their home. In addition, a constant stream of visitors from other chapters gave us our first joys of being a "national."

Due to our moving, and then getting accustomed to our new surroundings, we dispensed with all social activities during the month of September. On October 9, a smoker and entertainment was held. On this occasion some of our engineers showed that they had a decided historical inclination.

Saturday evening, October 20, was marked by a big banquet given by the Chicago Triangle Alumni Association for all the brothers within distance. At the end of the month of October a Halloween party gave our lady friends their first chance to look over the new place.

Henry Penn, who was recently appointed Assistant Professor of Civil Engineering, is one of us, in that he is an alumni member of the parent Triangle Chapter at the University of Illinois from which Professor Penn graduated in 1910.

During the past several weeks Triangle pledged the following men: Nienz, Larkin, McGlave, Goedhart, Pendergast, Schwartz, Reuter, and Chatroop.

ABSTRACTS

(Continued from page 25)

possesses certain advantageous properties to recommend it to the car owner. Ordinary lubricating oil is chemically treated and the treated material added to the gasoline in the proportion of one gallon of treated oil to five hundred gallons of gasoline. It is claimed that the resulting product gives approximately twenty-five per cent mileage increase. The lubricant introduced in this manner penetrates to every part of the engine cylinder and lubricates the upper part of the same not touched by the oil fed to the cylinder in the ordinary manner. Friction is thus reduced to a minimum and due to the elimination of excessive heat and pre-ignition, no carbon is formed. It is claimed that the mixture develops perfect atomization in the carburetor.

Scientific American.

Man Made Method of Clearing Fog

Several experiments made recently by Professor W. D. Bancroft of the Department of Physical Chemistry of Cornell University prove that fogs may be successfully dispelled.

The method used consisted of dispelling the fog by the precipitation of the tiny moisture particles. In tests conducted at McCook Field, Dayton, Ohio, the desired precipitation was brought about by the discharge of electrically charged sand from a rapidly moving airplane. The results showed that not only was the atmosphere surrounding the plane cleared but that a heavy rainfall, upon the ground below, followed.

If this method were found commercially feasible, it would undoubtedly prove of very great importance, both in dispelling dangerous fogs in harbors and providing, perhaps, rainfall in arid regions.

Sibley Journal of Engineering.

ATHLETICS

OUR COACHING STAFF

This year, due to the efforts of the Armour Tech Athletic Association, the Athletic Department is starting the season with the highest quality coaching personnel Armour Tech has ever had. With John Schommer as Athletic Director to supervise the department again, and with the present standing of the individual coaches, a successful season seems to be in view.

Basket Ball will be coached by Milton Romney, whose playing on the football and basketball teams of the University of Chicago caused considerable comment in 1921-22. Before entering the University of Chicago, Mr. Romney played for two years at the University of Utah, which won the Rocky Mountain Conference championship both years. They were also runners up in the national A. A. U. Tournament. He played for the University of Chicago in 1921-22, and on several semi-professional teams in Chicago. After graduating, he coached the University of Texas and turned out a championship team at that college. He will take charge of the Armour Tech basketball team on December 1. The team will be coached by Athletic Director Schommer until that time.

Track is again under the direction of Coach Phalen, and from the Fall activities of the cinder steppers, his work will undoubtedly show results in the spring.

Baseball will have a new coach. Professor Henry Penn has been secured for this position. Coach Penn has had considerable baseball experience in college and semi-pro circles. He is a graduate of the University of Illinois, and while there made a remarkable record as a pitcher. He played on the Freshman Varsity team in 1907, and on the Varsity team in 1908, 1909 and 1910. From that time until 1921 his baseball activities have been in semi-pro clubs. With both college and semi-pro experience, he should be a valuable addition to our coaching staff.

Tennis will be guided by Coach Tibbals, who has already scheduled and played a match with Northwestern University.

Wrestling is starting off early this year. Coach Smith was considerably handicapped by the late start last season, but will have much more time to devote to this year's team.

Swimming arrangements have not been completed, but at present it appears as though our men will again have the services of "Doc" White, University of Chicago coach.

Golf is being coached by Professor Leigh, and if the results and playing in the Golf Tournament are an indication of the material, the spring should see a much better team than last season.

GOLF

The Fall Golf Tournament was started about the third week in September with twenty-two contestants, and has been brought down at the present to six players: Melby vs. Dunlap, Miller vs. Johnson, and Urban vs. Fitzsimmons.

The tournament has not proceeded as rapidly as was hoped, but it should be completed before cold weather. However, it has served its purpose in bringing out new talent among the Freshmen.

The team that represented Armour Tech last year has lost Frink and Bates, who were our mainstays. However, Miller and Urban (freshmen) appear to have the ability to take their places.

The team will be made up of four men who may be challenged for their places at any time, by anyone desiring to do so. This system will keep the members from permitting their game to fall off during the season.

TENNIS TEAM LOSES TO NORTHWESTERN

On October 12, the tennis team, consisting of Ford, Kinsman, Castle, Peacock, and V. D. Taylor, met defeat at hands of the Northwestern University team. Our men were quite confident that the drubbing given Northwestern last spring would be duplicated, but nervousness, lack of practice, or any of a number of things that seem to have a permanent license to kick over the proverbial dope bucket, resulted in defeat by a 5 to 1 score. Taylor, playing third for Armour, was the only man who came out on top. Peacock lost 6-1; 6-3.

The Fall tennis tournament is not yet finished, so that Coach Tibbals had difficulty in determining the relative ability of the tennis material in school. Arrangements are being made that will give the team opportunity to practice two afternoons a week on indoor courts, and the tournament may be finished on these courts.

CROSS COUNTRY MEET

Northwestern College vs. Armour Institute of Technology

Eleven Armour men participated in the first cross country meet of the season 1923-24 on October 13. The competition offered by the Northwestern aggregation was anticipated long before the meet was a reality. The track meet of last year proved that the Northwestern nucleus was chiefly a composition of distance men, while our men proved to be far the best in the field events and the dashes.

With a few new runners added to the list of track men, and a number of old letter men and runners—from the previous season, Coach Phalen scheduled this meet with Northwestern College, under assumptions and expectations of the old and new material doing their very best for Armour colors.

The following men were entered in the tournament: Robinson, Heller, Abrahm, Ball, Gordon, McHenry, Berry, Payne, Sholz, Ohlhaver, Owens.

The course followed by the participants of the run is known as the River course at Northwestern College. About one and one-quarter miles of the four mile course is pavement and the remainder country road. A heavy rain was falling throughout the race making the pavement exceedingly slippery and the roads very rough and muddy.

Promptly at 2:00 P. M. the starting gun was fired. Stan Owens of Armour took the lead, and maintained a distance of 50 to 100 feet ahead for about one and one quarter miles. Then Riekert, Wuertz, Brocks and Lockwood, the backbone of the Northwestern team, took the lead and maintained it throughout the remainder of the race. Payne lead the Armour men, followed by Berry, throughout the four mile course.

The finish of the race saw the above named Northwestern men cross the line first followed by the Armour men, Payne, Berry, McHenry, Robinson and Ball, in their respective order. Too much credit cannot be given to our men for their perseverance in this new race. Though it was a loosing race in score, it was a gain in experience and a satisfaction of 100 per cent finish. The score Northwestern College 18, Armour 41.

The meets yet to be held are:

October 27, Triangular Race—Lake Forest.

November 3, Illinois Championship, 7 Mile Road Race—Kosciuszko Park.

November 10, Northwestern College—Washington Park.

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SOCIETIES

(Continued from page 26)

The Orchestra is the "backbone" of the assemblies, having made five appearances in such meetings to-date. W. B. Douglas, student conductor of the band last season, is now both conductor of the Band and director of the Orchestra.

Both organizations expect to have a very full season this year as engagements for them are being made by Professor Phalen, President Friedman, and Manager Brown.

The members of the Glee Club are determined to win in this winter's Intercollegiate Competitive Concert and in order that every chance may be afforded them, an urgent request is made that every student who has any qualifications along this line whatsoever see Professor Phalen and get in on the rehearsals immediately. Don't graduate with only the date of your birth and your vaccination certificate after your name in the "Cycle." Come out and do something and receive at the same time the hospitality, friendship, and good times enjoyed by the musical clubs.

RADIO CLUB

The opening of the school this year brings with it a new period in the history of the Radio Club. From the small beginnings of years gone by the club members are gradually developing, through their untiring efforts, a station worthy of Armour Tech.

Last term, receiver donated by Mr. H. G. Mathews of the Chicago Radio Laboratory, was installed. The transmitter, al-

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THE SLIPSTICK

CLAUDE ALBON STIEHL, *Editor*

EXTENSION COURSE
in the
COLLEGE OF ENGINEERING
for
THE YOUNGER GENERATION

LESSON NUMBER ONE
"COLLEGE YELLS AND SONGS"

1. *Defin.* "Yell"—an organized effort on the part of the student body to make the greatest possible noise at the most inopportune time.

2. *Defin.* "Rah"—the favorite word in all yells. No yell is complete without one. Usually repeated three to seven times.

3. *History.* Yells were first discovered by Columbus on the American continent during his visit of 1492. They were soon afterward imported to England along with other evils, such as tobacco leaves and sliced tomatoes. An investigation into the derivation of the word "Rah" shows that it was first used by the Indians on their canoe trips while pursuing the enemy, and was shouted, "Row! Row! Row!" The English (doubtless on account of the influence of beef) varied the pronunciation to "Raw! Raw! Raw!" The final Yankee transcription was logically the more collegiate "Rah! Rah! Rah!"

Example: Wow! Wah!
Goo-ga-da!
Armour! Armour!
Rah! Rah! Rah!

4. Defin. "College Song"—an excuse for standing up at assemblies and games, and giving away two hundred dollars.
Example:

Chanson des Enfants
(Dedicated to the Winston Twins)

I wanna go to Armour when I grow up big!
I wanna go to Armour where I'll study trig!
I has one firm ambition—
To take drawing in the Mission,
And learn what it means to "crib" and "cram" and "grind" and "dig"!

I wanna go to Armour when I grow up big!
But I will never go there as a Kappa Sig!
I might turn Delt or Phi Kap,
Or a Theta Xi, or mayhap
Beta Phi, if I can only wear a snappy rig!
Of course there is Triangle and Rho Delta Rho!
And Sigma Alpha Mu might point the way to go.
But when it comes to choosin',
I don't think that I'll be loosin',
If I make Tau Beta Pi with grades of one-oh-oh!

I'm goin' to go to Armour where I'll learn to know
What is it makes the wheels turn round and engines go.
And learn in those dusty hallways,
When Leigh asks us "When?" say, "Always!"
It's a more emphatic answer than a "Yes" or "No."

I wanna go to Armour when I grow up tall,
And it may be by that time they will have football;
And some ten or twelve years later,
I can take the elevator.
When I go to economics up in Science Hall.

So—I'm gonna go to Armour when I grow up big!
And study calculus if ever I pass trig.
And I know somehow or other,
When I hear, "Good morning, brother!"
I'll be glad I went to Armour when I grew up big!

TIME IS MONEY

The outstanding difference between a prof and a girl is that when the prof's ten minutes late you beat it and thank him; when the girl's ten minutes late, you're lucky it wasn't more.

POINT OFF!

Someone should open a lost and found department for misplaced decimal points.

The Armour man is chiefly distinguishable by a yawn and a brief case.

Usually the fellow who says, "I didn't hear the question," didn't see the text book, either.

Our splendid enthusiasm at assemblies sometimes achieves its purpose—to kill the next hour's class.

Speaking of the assembly hall, we'll say the seats are perfectly equipped for Armour students: there's a rack for your hat, a box for your books, a rest for your feet, and no place for your brains.

We have heard of "Ships that pass in the night"—we might say Armour is badly afflicted with "Trains that Pass in the Day."

APROPOS:

A hiss of steam and a mighty roar—
A swirl of smoke—then more! and more!
And meanwhile, Wilcox quite delights
To demonstrate his physics sights—
"And just a word before you go,—
Last night I got by radio . . . . . "

A clang of bells and the grind of wheels;
A tied down whistle's raucous squeals! . . .
And Scherger with an outstretched hand,
Tells all about how man was planned—
And why the Garden of Eden lark
Caused the recent fall of the German mark!

A puff and a wheeze—here's a dismal freight—
I count the cars, there's eighty-eight . . .
Dean Monin introduces us
To all the philosophic muss;
And mixes th' eternal mystery
With bits of private history.

Now bells in a chorus—four engines' loud din—
Two trains racing southward, and two coming in . . .
And Cooper in his English class
Hears themes on, "Why I'm green as grass;"
Or, taking up his mighty pen,
Intones the words, "Now, gentlemen—."

Some trains are bound Manhattan way,
And some to San Francisco Bay;
Some trains are fast trains, some are slow,
And day and night they come and go.
No matter who the speaker is,
Or what he talks about:
Experiment, lecture, class, or quiz—
The engine drowns it out!
Physics must pause in its mighty stride,
Philosophy, English, and Poli-Sci,
And Education stands aside
When a Limping Local passes by!

Sign to Place Over the Foundry Shop Door:
"Abandon Soap, All Ye Who Enter Here!"

THIS ISSUE'S POOREST JOKE:
(*Editor's Note:* Contributed—not responsible)

Don: "Did you get back your physics quiz?"
Wan: "Sure."
Don: "What did you get?"
Wan: "Left!"

Joe: "I got my picture taken and it didn't cost me a cent."
Andy: "You mean the photographer took you for nothing?"
Joe: "No. For somebody else!"

The Secret of Success still remains to be told.

An examination is usually a test in seeing who can get the most information on to the smallest piece of paper.

"Oh, Mister Thoelecke!
Oh, Mister Thoelecke!
You're the very man I'm looking for today!
Here's a well-known implement,
That some wise guy did invent,
That will make the man just pay and pay and pay!"

"Oh, Mister Stiehl!
Oh, Mister Stiehl!
More than once that's caused my head to rock and reel!
It comes to each engineer
In the course of his career—"
"Is it slipstick, Mr. Thoelecke?"
"No, it's lipstick, Mr. Stiehl!"

We are well aware that the above, according to latest statistics, is probably verse number 98,762, but like the world's population—there is always room for one more!

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THE RESPONSIBILITY OF EDUCATION

(Continued from page 10)

others are all doing specific things—things mostly prefixed with the dollar mark—and no one is concerning himself with conditions which make the dollar worth while. It is our problem—everybody's problem. It cannot be left to another. Each must do his part. Otherwise in place of strength which comes of united effort there will be weakness which comes of separated effort, or of no effort at all. Just think, gentlemen, what united effort did towards winning the war, and what is happening now when the bond of union is not broken but only weakened. We do not voice our thoughts, but millions all over the world are asking themselves "What has the future in store for civilization?" The answer (if answer there be) will be found in the past—partly at least. By analogy we may project our reasoning from the past into the future—ever remembering that human nature is subject to but little change. We may then cast about to discover what (if anything) this age of ours has contributed that is likely to make a difference. In this connection let me make a suggestion.

The late Dr. Flinders Petrie (the Egyptologist) wrote a wonderful little book (25 or 30 years ago) entitled "Revolutions of Civilization." Let me suggest that you possess yourselves each with a copy. It has an engineer's diagram at the end and can be read in two or three hours. Carry it in your pocket, if going on a journey, and read it a second time. I have myself already read it several times—parts of it half a dozen. It gives one a vision of civilization going back 6000 years B.C. (8000 years before now). In that time there have been several (half a dozen) distinct and separate civilizations, each springing from the ruins of the one preceding. Like man they have been born, grown to maturity, declined and died. Their lifetimes have varied from 1000 or 1100 years up to 1900 or 2000, the average being 1300 or 1400 years. All have contained the same or similar phases coming at corresponding times. Our own sprang out of the wreck of the Roman civilization—some time in the Dark Ages. Its ascent was marked during the period of the Renaissance. Have we yet reached the summit and shall we soon begin the decline? Who can say?

If you ask what have we contributed that former civilizations did not have and which if cherished and used intelligently may prolong if not perpetuate our own, I will answer that we have contributed what I think must be one very distinct thing, namely, EDUCATION—education of the masses. And because we know that there was education of a kind in the past, I would differentiate and say that our great achievement in education has been in the development of the SCIENCES and in their APPLICATIONS. The engineer's special field has been to reduce to practice the discoveries in certain of the sciences and make them available to mankind. His has been a creative work. Indeed the root word of engineer, namely, *gen*, is the same as in Genesis, and finds itself in all languages meaning the same thing—*to create*. The engineer's creations, puny as they are in comparison with the creations in Genesis, have been wonderful. No tale of the Arabian Nights can compare.

And now let me jar you again, gentlemen, by asking what, with all his splendid achievements, has the engineer ever done to help preserve the things he has created? Let me go further and ask of all the thousands, and hundreds of thousands of educated men and women, what *they* have done to help preserve the civilization which they have had part in building? I leave you to find the answer. Here then lies our great work in the future—for the future. A new trail must be blazed, the end of the trail being the prolongation of our civilization. The responsibility must be shared in by all, particularly by those who have had the opportunity for education. The world looks to them, and has the right to expect them to point the way. If the thousands of young men and women who are now graduating from our colleges to commence their work out in the world, and if the thousands who have preceded them and who will follow in the years to come, shall fail the world, then must we say that in comparison with earlier civilizations, our own has contributed naught to prolong life notwithstanding it has achieved the truly wonderful for our comfort, our convenience and our pleasure. We shall have failed. *This then is the responsibility of education.*

These are the views and opinions that have come to me after nearly half a century spent in engineering and in teaching. They are not born of pessimism—which is an idle and futile state of mind—but of faith. Faith that: with knowledge of the facts and comprehension of their meaning; with clear and clean thinking; with power to reason from premise to conclusion—a power to be expected of all truly educated men and women (whether college bred or not); this civilization of ours will not suffer the fate of its predecessors. Certainly it need not. But we must recognize the general lack of understanding and bend our efforts to preparing ourselves, as early as practicable for the campaign of education which, if we are honest with ourselves, we know must be engaged in. If, then, as engineers you have not yet found the time or been inclined to pursue certain fundamental study in subjects outside of your special line of work you should make up the deficiency as soon as practicable. This you can do yourselves because of the training which you have had. Your mind should be well organized and capable of receiving, digesting and assimiliating subjects with which you may not at first be familiar. And be not afraid! You will find joy in the work—a never failing fountain of joy which will keep you young in spirit even when the backward view on life shall have become for you (as it has for me) the long view. In the profession of engineering I charge you never to forget that

"*In the beginning God created the heaven and the earth,*" and found his work good—found joy in it. *He* was the Great Builder of *material* things. I charge you, what is even more important at this particular stage of our civilization, to take for your example in life the Great Builder of *spiritual* things, the Master Teacher of human relationships, who taught.

"*I am the light of the world; he that followeth me shall not walk in darkness, but shall have the light of life.*"

ATHLETICS

(Continued from page 29)

Final Results of Freshman-Sophomore Track Meet

		Time	Points Soph.	Points Fresh
100 yd. Dash:	1st Goers	:11.00	5	
	2nd Perry		3	
	3d Downs			1
	4th Long		2	
220 yd. Dash:	1st Goers	:25.8	5	
	2nd C. B. Davis			3
	3d Lusche			2
	4th Zimmerman		1	
440 yd. Run:	1st Goers	:59.2	5	
	2nd Long			3
	3d Harrower			2
880 yd. Run:	1st Ball	2:13.6		5
	2nd Olson		3	
	3d Payne			2
	4th Abrahams		1	
220 yd. Low Hurdles	1st Perry	:30.4	5	
	2nd Price			3
	3d Harrower			2
120 yd. High Hurdles	1st Perry	:19.2	5	
	2nd Price		2	3
	3d Busch			1
	4th Morrison			
Broad Jump	1st Busch	17'9"	5	
	2nd Hammer		3	
	3d Soule			2
	4th Johnson		1	
High Jump	1st Barfield	5'5"	5	
	2nd Johnson		3	
	3d Hammer		2	
	4th Busch		½	
	Morrison			½
Shot Put	1st Hogan	33'4"	5	
	2nd Johnson, C. D.		3	
	3d Johnson, W. E.		2	
	4th Hammer		1	
Discus	1st J. McLaren	97'7"	5	
	2nd Danziger		3	
	3d Johnson		2	
	4th Hefner			1
Mile Run	1st Payne	5:12		5
	2nd Sargent		3	
	3d McHenry		2	
	4th Scholz			1
2 Mile Run	1st Payne	12:55		5
	2nd Sargent		3	
	Total Points		85½	41½

High Point Men:
Goers (S) 15 points.
Perry (S) 13 points.
Payne (F) 12 points.

Registration First Semester 1923-24

	Seniors	Juniors	Sophomores	Freshmen	Specials	Total
Mechanical	42	33	42	47	..	164
Electrical	33	42	49	53	1	178
Civil	36	15	33	44	..	128
Chemical	25	22	18	34	..	99
Fire Protection	22	22	22	32	..	98
Architecture	11	14	23	33	3	84
Industrial Arts	11	..	..	..	..	1
Total	170	148	187	243	4	752

TALKING FROM NEW YORK TO LONDON

(Continued from page 20)

ing station may measure the strength of the received signals, and in intervals between tests, measurements are made of the disturbances coming in to the receiving set. This testing will continue throughout 1923 and, when finished, will provide very valuable information for use in the future for the design of a commercial telephone system.

At the transmitting station a number of new methods are employed which are somewhat similar to the advanced methods for multiplex telephony now in commercial use on some of the long lines of the American Telephone & Telegraph Company. The system employed realizes two very important advantages: first, the range of frequencies required for the message is only about one-half that required in ordinary methods of radio telephony, which is an extremely important advantage at the long waves necessary for trans-atlantic operation; second, the same method which secures this economy in frequency range also produces the same strength of signal with only about one-quarter the power usually required for this purpose. This also is an extremely important advantage for long distance operation in which the power required is measured in hundreds of kilowatts. At the transmitting end a modulated wave of the special type described, in which only the essential one of the three components is utilized, is prepared at low power. This signal is then amplified to 300 watts, then to 5 kilowatts and, finally, by means of a power tube amplifier, to approximately 100 kilowatts, after which it is transmitted to the antenna. The 5 kilowatt and 100 kilowatt amplifiers consist of water-cooled vacuum tubes operating at from 6,000 to 10,000 volts.

THE TECHNICAL MAN IN THE RUBBER INDUSTRY

(Continued from page 18)

Very few rubber factories at present are spending much time on purely theoretical research. The most important problems yet to be solved are the cause for the action of accelerators, cause for the action of fine compounding ingredients, the perishing or aging of rubber goods, and the development of methods and machines for making accurate physical tests on both vulcanized and unvulcanized rubber.

Seneca said: "He that has conferred a kindness should be silent, but he who has received one should speak of it."

—Glen Falls "Now and Then"

E. C. M. A.

(Continued from page 23)

THE ARMOUR ENGINEER is accompanied on the E. C. M. A. probation list by *The Carnegie Technical Journal* and *The California Engineer.*

The membership application of THE ARMOUR ENGINEER forms to us an interesting sequel in the history of the E. C. M. A. For the convention which led finally to the inception of E. C. M. A. was held in Chicago in February, 1920, and was attended by a representative of The Iowa Engineer, a representative of Roy Barnhill, Inc., advertising agency, and Mr. F. E. Hayden, Business Manager of THE ARMOUR ENGINEER. However, despite Mr. Hayden's able pioneering, until recently conditions made it impossible for THE ENGINEER to make the changes necessary for admission to E. C. M. A.

The "Engineering College Magazines Associated" represents the best in technical college publications in the country. We feel that our journal will be benefitted and honored by such an association, and that through its early effort toward the cause of the E. C. M. A. and its own present merit, it is wholly worthy of such associates.

THE SLIPSTICK

(Continued from page 30)

If Our Schools and Colleges Advertised in the Elevated:

Our Own Columbia: "They're mild, but they satisfy."

Armour: "Your nose knows."

Chicago Dental College: "You can do it better with gas."

Parker School for Penmanship: "Hasn't Scratched Yet."

Western Undertakers College: "Eventually, why not now?"

Art Institute: "While there's Life, there's hope!"

COLLEGE LIFE AT ARMOUR LAID BARE

Revelations More Startling Than Those Revealed in "Town and Gown" are Disclosed in Special Article for "The Slip-Stick."

EDITOR'S NOTE:

It has come to be the rather remunerative custom among otherwise little-known individuals to publish their startling disclosures of college life as they had hoped to find it—and didn't, in the form of more or less sensational accounts. To show that Armour is not lacking in material of this nature, we publish the following naive fragment as indicative of the immense possibilities surrounding our little boys.

DOWN AND DOWN

By

Ihaitu Thinkit

CHAPTER ONE—BY THE GLARE OF THE LAMP

I had paced the streets an hour or more, and she had hung heavily at my side. I did not know where I could leave her—nor would I have dared, even had I so desired, for now she belonged to me. But I was sick of it all, trying blindly to see my way out, yet slipping so surely, with the inevitable ending that I dreaded must come. We had come to the fraternity house, and quietly, almost stealthily, I took her up with me.

I am no better than other men—and no worse. It was a year at college—a miserable, grinding year that had brought me to this; and the others were all out, no one would see me.

I donned my bathrobe and took her on my lap. She made no effort to oppose me, except that her back was stiff.

"My beloved Calculus," I whispered tenderly, "now I shall study thee—I shall know thee—thou art in my power! Calc," I said, becoming more familiar, "we have long been together, in classes, and on the streets; in the day you are at my side, in my dreams you are ever before me. Yet ever have you repulsed me. You would not let me understand you! You would not reveal to me your inner self! But we must come to an understanding. I do not want to stay with you. To pass you, to go on, is my one desire. I am cruel, I know! Yet, I beg of you, be mine for these few brief weeks, then let me pass on. I shall swear and promise never to forget you, and yet—and yet—!"

At that crucial moment, the door opened, and my room mate came in. He had been out carousing, buying two hideously lined sheets of paper and a wickedly soft eraser. At a glance he perceived the entire horrible situation.

"Ihaitu Thinkit!" he exclaimed, and my beloved Calc slipped to the floor in a dead heap. The shame that came over me as I saw him cover his eyes with his hands. I was only able to murmur in a voice filled with guilt, "Forgive me! I guess—I guess I went too far this time!"

I shall never forget the way his voice shook with grief as he answered, "Yes, oh yes—you did! It was only to page forty-nine, and you worked all the way thru to fifty-seven!"

COLLEGE NOTES

(Continued from page 24)

Scholastic Standings

The following statistics, compiled by the Office of the Dean, give the scholastic standings of the members of the Freshman, Sophomore, Junior and Senior Classes of the College of Engineering and Architecture, who were in attendance during the second semester of the school year 1922-1923. In this computation the grades in Physical Training were omitted. A credit, either for work at the Armour Institute of Technology or for work elsewhere, was considered equivalent to a grade of "B."

The average of the entire school body, a total of 653 students is 86.54 per cent.

The averages of the various organizations are as follows:

The Senior Class.....89.00
The Junior Class.....87.70
The Sophomore Class.....85.25
The Freshman Class.....84.97

The highest student in the Senior Class was Mr. Erling A. Arentz whose average was 95.0.

The highest student in the Junior Class was Mr. John Henry Sweeney whose average was 94.8.

The highest student in the Sophomore Class was Mr. Milton F. Adair whose average was 95.9.

The highest student in the Freshman Class was Mr. Arthur S. Hansen whose average was 96.4.

Mechanical Engineering Department.87.14
Electrical Engineering Department..86.21
Civil Engineering Department.....86.58
Chemical Engineering Department..87.12
Fire Protection Engineering Department.....86.50
Architectural Department.....83.50

THE HONORARY FRATERNITIES

Tau Beta Pi.....92.5
Scarab.....86.3
Eta Kappa Nu.....90.2
Phi Lambda Upsilon.....91.5
Salamander.....91.1
Chi Epsilon.....90.8

SOCIAL FRATERNITIES AND CLUBS

Phi Kappa Sigma.....85.6
Delta Tau Delta.....85.4
Theta Xi.....85.7
Sigma Kappa Delta.....86.1
Beta Phi.....84.3
Sigma Alpha Mu.....87.5
Rho Delta Rho.....87.6
Tau Delta Phi.....86.9
Triangle.....86.9

The average of all students belonging to the Phi Kappa Sigma, Delta Tau Delta, Theta Xi, Sigma Kappa Delta, Beta Phi, Triangle, is 85.6.

The average of all other students is 86.9.

In the above, the following numerical values were given to the letter grades: A=97.5 per cent, B=90.0 per cent, C=80.0 per cent, D=67.5 per cent, E=50.0 per cent.

At the recent meeting of the American Aeronautic Association at St. Louis, W. E. Schweitzer won fifth place in the model airplane contest. Mr. Schweitzer built and flew a monoplane.

The first round of the Freshman Class election took place in the Mission on October 10. In spite of the fact that the bulletin board notice said "All Freshman should be present," a fairly large proportion of the class were there. Also, not over a dozen "proxies" appeared, bearing evidence to the fact that this Freshman Class is no different than any other.

As is indicated above, an election, or part of one, took place. That is, it took place among other things. It took place after the Frosh had, with marked fortitude, sat through the wonted dose of good advice they had coming to them.

At any rate, this first hour culminated in the selection of the following officers:

President.....M. F. Davis
Vice-President.....J. W. Tasker
Secretary.....L. Miller

At the second preliminary competition for the 16th Paris prize of the Society of Beaux-Arts Architects, I. J. Loebl, class of '21, was placed first, and H. K. Bieg, class of '22, was placed third. The subject of the preliminary composition was "A Summer Hotel."

"The world has something worth while in it for everyone if he can only find it I pray God every day that He will help me to find my work—the thing I can do better than anything else; and when it is found, help me to do it."—Abraham Lincoln.

THE ARMOUR ALUMNUS

(Continued from page 22)

rooms of an apartment house. The boys are happy to state that Mrs. Powell is still with us as our house mother, a role which she fills very graciously by making the fraternity a real home for "her boys."

R. D. Fisher, '23, is engaged in the Students' Training Course of the General Electric Company at Schenectady, N. Y.

E. F. DeBra, '23, was married to Miss Elsie M. Hartel of Kearney, Missouri, on Sept. 18, 1923. They will be at home after October 3, at Los Angeles, Calif.

C. W. Hauth, '23, was married to Miss Ellen Larson, Aug. 31, 1923. Mr. Hauth is with the Illinois Inspection Bureau.

R. O. Matson, '23, was married to Miss Anna Nyvall, June 1st, 1923. They will make their home at 3242 Sunnyside Ave., Chicago.

George Crane and Jim Spensley are doing their stuff, chemically speaking, in New York City.

"Swede" Johnson is an architectural designer for Foltz & Brand here in Chicago.

Followers of football have no doubt seen Schommer's name in the tabulated score of the games. He is one of the leading game officials for the Western Conference Colleges, known as the "Big Ten." He is a keen student of the game and the rules, and has built up an enviable reputation as a football official.

From a recent number of the "Twin City Dealer" house organ of the Minneapolis Steel and Machinery Co., we dip an item about Mr. J. A. Teach, A. I. T., class of 1904, as follows:

"Another important change in the management was consummated in January, when Mr. J. A. Teach, who has since 1919 been located in New York City as our representative; was brought back to Minneapolis and made General Superintendent of the shops. He has complete charge of production including the Structural Mechanical and Locomotive Repair departments of our plant. Mr. Teach is a graduate engineer with years of experience in both mechanical and structural engineering. He came with this company, February 1, 1910. Mr. Teach besides being a trained engineer is a man of shop experience, systematic and possessed of executive ability. His unfailing courtesy and consideration for others peculiarly fits him to handle an organization. There is something the matter with the man that doesn't like 'Jake.'"

A recent visitor at the Institute who had some interesting experiences to relate was R. R. Maquire, '12. When he graduated he decided that he would see some more of the world before buckling down to the well-known job. He sailed from Canada on a British freighter, working his passage. During the trip over he experienced nothing but hard work, occasional rough weather, and rougher treatment from the crew, who regarded him as a Yankee land lubber.

During his trip he visited almost every country in Europe, but spent most of his time in France, Belgium, Germany, Switzerland, and Italy. He found that it was not difficult to find a job, so whenever funds got low he would stop and work for a while. Much of his traveling was done on a bicycle, which further reduced expenses, so that he saw Europe at surprisingly little cost. Of course, his American money went farthest in Austria and Germany; here his hotel bill would be about 50 cents a month, and when the price of cigars went as high as one-half cent each he stopped smoking to discourage the profiteers.

Maquire is now home again and hard at work for the Illinois Steel Co. He plans to learn the steel business from the bottom up, with the idea of going later into sales work. With him the "bottom" has proved to be building backwall in the open-hearth furnaces. Everyone familiar with steel mills knows that this is hard, hot work, but Maquire doesn't seem to be afraid of it, and will stick to it until he is moved along to some other job.

In this, our first issue of the current college year, we regret very much to record the death of Arthur H. Anderson, A. I. T., '02, who passed away September 1, 1923. Mr. Anderson was well known to a large number of Armour men, through his thirteen years of service on the Institute faculty, as Associate Professor of Experimental Engineering.

During the war Professor Anderson resigned his position at the Institute to engage in business in the manufacture and sale of a fuel economy gauge for steam boilers. During the strenuous days of enforced fuel conservation, this instrument was in great demand and he worked literally day and night in its promotion. After the war, when government regulations were withdrawn, many users of coal dropped back into their old wasteful ways. Professor Anderson then returned to the more congenial life and surroundings of academic work. He became Assistant Professor of Steam and Gas Engineering in the University of Wisconsin, and it was in Madison that his death occurred.

Arthur Anderson had a host of friends at Armour Institute of Technology, who mourn the untimely passing of as gentle and kindly a soul as it has ever been their privilege to know.

RADIO CLUB

(Continued from page 29)

though not as efficient as it might have been on account of absorption by nearby structures, has been heard on both coasts.

This year the club has secured an appropriation from the Student Activity Fund for a new eighty foot mast. The mast was erected by club members in the space behind Chapin Hall. An inverted "L" type antennae consisting of six wires of number 10 copper, together with a counterpoise made up of eight number 10 solid copper wires form a radiating system which should bring our transmitter up to maximum efficiency.

From October 15 to November 3, trans-Pacific tests were conducted with amateurs in Australia and New Zealand. To date no reports have been received as to whether or not our broadcasting was heard. Inter-collegiate traffic will soon be carried on.

During September of this year the second national convention of the American Radio Relay League was held in Chicago. W. E. Schweitzer, president of the Armour Radio Club during the last year, was convention chairman. F. J. Marco, the new president, and R. H. G. Mathews, a former student of the Institute were members of the executive committee. Amateurs from all parts of the United States, Canada, and even a delegate from France attended. At the technical meet-

(Concluded on page 38)

RADIO CLUB

(Continued from page 36)

ings the leaders in radio communication gave interesting and instructive talks on all the phases of both transmitting and receiving.

The first meeting of the club this year was held October 18. Officers for the coming year were elected as follows:

President.....F. J. Marco
Vice-President.....D. J. McFaul
Secy-Treas......E. Posselt
Chief Operator.....L. M. Endres

Meetings will be held on the odd Thursdays of each month at the eleven-thirty hour. Programs for the coming meetings are being arranged and some excellent speakers are expected. These meetings are open and we will welcome interested visitors.

"How would you prefer to die, if you were to choose?"

"Get caught in a stampede of Buffalo nickels."

Sec.—"Here is notice of another suit for damages to cattle."

Pres.—"Heavens! Have our locomotives killed more cattle?"

Sec.—"No. The claimant affirms that the passengers lean out of the car windows and milk his cows."

"Who's that guy you were talking so nice to?"

"Aw, that's my old family druggist."

"What did he say?"

"No!"

Sealite Serves a Double Purpose

The Standard Oil Company has recently developed a product known as Sealite for the purpose of retardation of evaporation from the surface of crude oil or gasoline in storage. This new substance promises to serve a double purpose for the fire hazard of oil storage should be materially decreased, both by decreasing the amount of explosive vapors given off and by acting as a smothering blanket in practically the same way as the ordinary foam extinguisher. This is an interesting instance of a development primarily for a commercial purpose, incidentally improving fire hazard conditions.

N. F. P. A.

The Armour Engineer

PUBLISHED BY THE STUDENTS OF

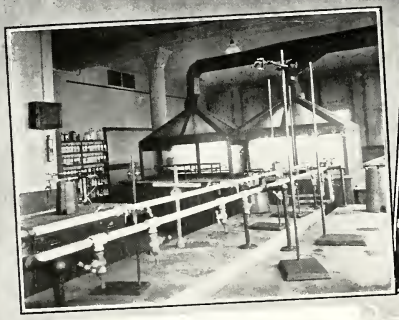
Armour Institute of Technology

VOLUME XV JANUARY, 1924 NUMBER 2

Table of Contents

We urge our readers to take advantage of the technical information that our advertisers will gladly furnish upon request

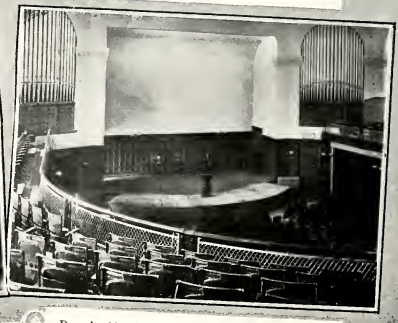
The Gas Engine Laboratory. Toward the rear on the left appears the object of the now classical G6.



A corner in the Organic Laboratory. Needless to say, this picture was made during summer vacation.

"Oh, Where and Oh, Where Is Our Highland Laddie Gone?"

Where the Freshmen and Sophomores study.



Doesn't this give you a thrill of the old Armour Spirit? Rah, rah, rah, for everybody!

THE ARMOUR ENGINEER

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BUSINESS IN PERSPECTIVE

By

ARTHUR REYNOLDS

President, Continental and Commercial National Bank of Chicago

PERSPECTIVE is needed in business just as much as in architecture—perhaps more. In the press of daily duties it is very easy to see particular happenings in a particular business or a certain line of business but to miss part of the general trend of events. Information in the newspapers about business is often disconnected and fragmentary. Today the business man may note the progress of Mr. Mellon's tax bill in Congress, the increase in the price of gasoline or the rise in U. S. steel stock. Tomorrow he may see figures showing the position of the Federal Reserve Banks. And so it goes. If he wants a picture of the business situation as a whole and in perspective, he has to make a systematic appraisal of a large number of economic forces, and their interplay.

To be sure, a business man can use statistical services, of varying merit, in trying to get perspective. But each executive should reserve the right to reach his own interpretation of business facts on the basis of his own experience, prejudices and predilections. He will find no ready made formula that will completely fit his needs. He must put his own perspective into his own picture.

So much by way of a general prefatory statement. It has seemed necessary because an accurate appraisal of the business situation has required perspective, particularly throughout the second half of 1923. If new records were not set day after day or month after month in all lines of business and all sections of the country, people wondered if fundamental conditions really were sound. Incidentally, some are still wondering. In February and March the fear of inflation was wide-spread, when there was no inflation. Later, when the stock market began to sag, people shifted almost overnight to the fear that the end of good business had

Mr. Arthur Reynolds.

come or would soon be here. Other illustrations could be given. The need of perspective is not idle preachment.

Business in 1920 and 1923

It is helpful in getting a perspective of the business outlook to note some of the things that happened during the depression of 1920.

We were told repeatedly that there could be no revival of American business until Europe completely recovered from its political and economic ailments. But some of us believed that a measurable improvement in business could come long before the sore spots in Europe were entirely removed. Events have proved that those who were considering the possibilities of business at home were sound in their judgment. Business expansion had actually begun by January, 1922. Undue emphasis on the European situation gave a distorted perspective.

As late as July and August, 1920, a large percentage of business men felt that their inventories were not abnormally heavy. They were deluding themselves, and in some instances deceiving their bankers, as business contraction was already upon them. The precipitate decline in prices and consequent shrinkage in inventory values is a familiar story—one that business men are not likely to forget in the near future. In 1920, production and consumption were out of line. Maladjustment between inventories and demand was one of the worst features of the "deflation" that began about the second half of that year.

Much was made of the decline in the stock market from March till the last quarter of 1923. The decline beginning in November, 1919, was cited as precedent for the view that the stock market again indicated business depression. However, one significant fact about the 1920 situation was overlooked. At that time there was a marked tension in the money market. Commercial paper rates were about 8 per cent bid and, perhaps, might just as well have been 80 per cent. Stock prices began to decline but money rates kept going up. Business, some months later, began to contract, while money rates continued to rise. It was still later, fully a year, before money rates started to fall. This is the usual sequence of events during the liquidation stage of a business cycle. In 1923 there was no such tension in

(Continued on page 71)

PLANNING AND PRODUCTION CONTROL

By
NORMAN F. KIMBALL, '12
Production Engineer, The Foamite-Childs Corporation

THERE is really nothing new in planning—that is, how and when work shall be done. Ever since Noah very definitely planned how he was going to build the Ark, all businesses, especially manufacturing, have always formulated certain plans before the enterprise is started. Planning begins with the choosing of the location of the plant, design and construction of the buildings, purchase and installation of machinery, sales policies, financial problems, and so on. Planning has to do with the brain work of business and extends into every department of an industry. This is the broad general meaning of planning.

It will be the purpose of this article to discuss planning, or production control as it is sometimes called. Planning, as to how, when, and what work is to be done, introduces a number of elements which must be carefully analyzed. Planning, as applied to production, is a summation of these various elements.

The term "planning" has, with the growth of our manufacturing establishments and its attendant mass production, taken on a new meaning. Production, the essential factor in industry, is now regarded as a physical problem which can be definitely measured, analyzed, and controlled. Intelligent production control, which is often the determining factor between success and failure, has brought about highly specialized planning departments. Just as we have specialized purchasing departments, stores departments, engineering departments, and so forth, so have specialized planning departments been established.

The planning department adds no radically new functions to manufacturing or production. It merely organizes and concentrates the different planning functions in the hands of a few persons who are experts in their fields, just as certain engineering functions are concentrated in an engineering department, or in a cost department where expert accountants figure costs. The centralized planning department carries out the idea of specialization in industry along a new line, and was brought about by the magnitude of complexity of our modern business organizations.

Planning, or production control, is the heart of factory operations. The sole purpose of any manufacturing institution is production and the output of any factory will be greatest when its operations are carried out in accordance with certain definite plans. A properly conducted planning department is therefore the center from which all plant activities radiate. The planning department is an instrument of executive control and coordinates all the various factors in production. The planning department of today pictures to the executive (a) past performances (b) present conditions and (c) future possibilities.

Before starting upon the manufacture of any article, whether a carpet tack or a complicated piece of machinery, the first question that will most likely come up is the possible sales of the product. "What will be the demand for this article?" After the knowledge is had of what to make and the quantity to make, it is necessary to find out what raw materials are required and how much of each kind of material is needed. Then the question arises as to what machinery must be purchased to carry on the manufacturing operations, and what gauges, jigs, tools, and other accessories are necessary to insure economical production. The various manufacturing operations should then be analyzed and studied and standards as to time and methods be ascertained. Inasmuch as certain records, forms, and specifications will be necessary successfully to carry on the work, these must be prepared. Lastly, the men who are to carry on this business of planning must be organized into a compact and "closely knit" department.

From the preceding paragraph, it can be seen that planning or production control divides itself into certain elements or divisions which can be classified as follows:

Sales or Demand—What is to be made, what quantities are to be made, and when they are to be delivered.

Stock or Material—Analysis of the sales into the materials required.

Machinery or Equipment—Machines, accessories, and the arrangement of same to carry on manufacture.

Standards or Time Studies—Determination of the best method of operation and standard time required for each operation.

Methods of Control—Mechanism for visualizing the production problems.

Organization—Form of the production department.

Production is governed by sales and it is only possible effectively to control production by having an exact and comprehensive knowledge of the sales or the demand. Therefore, before starting on planning, or the control of production, it is necessary to secure full information regarding past sales and likely future sales. What the sales will be in the future is largely determined by what has been done in the past. A complete and careful analysis of the sales of each article should be made for at least three years back and tabulated by months or quarters. It is then possible to compare the sales within a certain year and also the trend from one year to another. It sometimes happens that tabulated data is hard to grasp and it is often desirable to present the facts graphically by plotting curves.

Attention should be given to the variety of parts or the extent of the line that the trade requires. Economy of production often results from standardization of a line of many articles by selecting parts which can be processed similarly or else used for many different articles. The quantity to be manufactured and the delivery requirements have, of course, important effects upon production control.

Having determined what is to be made, how much of each article is to be made, and when these articles will be needed, the next step is to reduce this information into the kinds of raw material necessary to produce these articles. Standard specifications and bills of material should be drawn up showing all of the different parts entering into each article, the number of each parts per unit article, and the material of which each article is made. All of this is necessary in order that the purchasing department may function intelligently and provide the material in the right quantity and at the right time for manufacture.

Each individual part must next be studied as to the different operations in processing and what machinery and tools are needed. Standard instructions or operation sheets are to be compiled showing in detail all the steps or operations in sequence entering into the

(Continued on page 70)

THE TECHNOLOGY OF GELATIN

By

FRANK R. JOHNSON, '18

Chief Chemist, United Chemical and Organic Products Company

GELATIN is made from skins and bones. The skins are divided into two classes, those which require dehairing and those which do not. In the first class are hide trimmings, pieces that are trimmed off the hide in preparing it for the tanner, and faces. To the second class belong pig skins, raw hide trimmings, and so forth. Bones may be cooked under pressure, yielding a low testing gelatin, or they may be treated with dilute acid to remove the mineral matter producing ossein from which a high grade gelatin may be made.

Hoofs and horns will not yield gelatin — a noteworthy fact for Professor Wilcox' book of popular fallacies. The base of hair, nails, feathers, hoofs and horns is keratin, which yields such bodies as hydrogen sulphide and the mercaptans when hydrolyzed. The base of skins and the organic matter of bones is collagen. Gelatin is produced by hydrolyzing collagen.

The most simple stock to treat is pig skin. Fresh skins contain about 55 per cent water and 8 per cent grease. Salted skins will analyze 35 per cent water, 13 per cent grease, and 20 per cent salt. The skins are unloaded into a large cone washer where they are washed until thawed or until the salt is removed. Fresh water is now run in and a small amount of muriatic acid to cause plumping. The skins are again washed to a definite hydrogen ion concentration determined by the use of indicators on cross-sections of the skin.

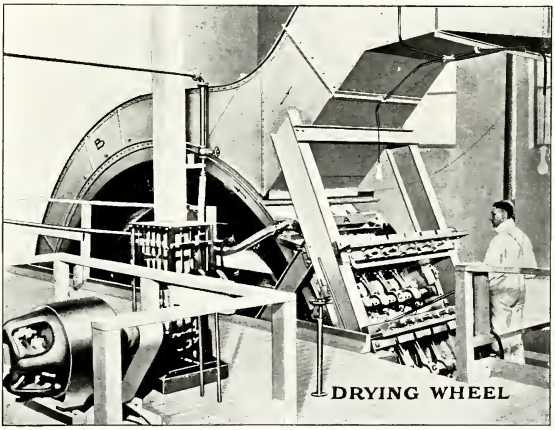
The success of the cooking operation which follows depends largely on the accuracy with which the pH is controlled. About 5,000 pounds of skins are loaded from the washer to a vertical tank and covered with boiling water. Hydrolysis of the collagen commences at once and the water begins to pick up weight. As soon as the liquor weighs .5 degree Baumé, the rendered grease is skimmed off and the first run is pumped to the filters. The skins are again covered with hot water and as soon as it picks up sufficient weight it will be pumped to the filters as a second run. This process is repeated until the skins are cooked out, that is, when boiled, no further hydrolysis takes place.

The cooking operation is a very important one. The skill and punctuality observed in its execution has a striking relation to the value of the finished gelatin. Excessive heat in hydrolyzing or in maintaining the liquors preparatory to drying reduces the jelly strength.

Before pumping through the filters, it is necessary to add a small amount of filter cell to prevent the slimes from blocking the filter. The filtering operation is largely facilitated by maintaining the proper degree of acidity (pH).

After filtering the liquor should be dried with all possible dispatch. There are two general processes in use at the present time. The first and oldest is known as the tunnel process, the second, a patented process used exclusively by our company, is called the wheel process. Psychrometric conditions and expensive refrigeration units, which play so important a role in the tunnel process, are entirely eliminated in the wheel process. A brief description of the two systems of drying follows:

Tunnel drying requires three separate units, a chilling device, drying tunnels, and a crusher to break up the dried sheets. The chilling device consists of two narrow chambers about 100 feet long. Each chamber is an operating unit and is divided in half horizontally. In the lower compartment is a continuous rubber belt on which the gelatin liquor is deposited at one end and removed as a jelly at the other end. The upper compartment contains a bank of refrigerating coils and a small power fan which causes a positive circulation of cold air in the lower compartment. A temperature of 10 degrees C. is maintained except for extreme seasonal conditions. On the roof above the chambers is an oil soaked coke, air filter. All the air coming in contact with the gelatin liquors or that in process of drying is drawn through these or similar filters. They are highly efficient from a dust and bacteriological



The improved process for drying gelatin, whereby bacterial contamination is reduced to a minimum. This process is used exclusively by the United Chemical and Organic Products Company.

standpoint. The warm gelatin liquor is fed on the belt at the far end and as it travels through the chamber it is chilled to form a stiff jelly by the time it reaches the near end of the belt. Here it is removed by a knife placed at the proper angle, and deposited on an auxiliary belt running in the same direction and a bit below. The continuous sheet of gelatin, about one-quarter of an inch thick, is automatically cut into lengths suitable for the frames on which it is deposited. The frames, each supporting a sheet of gelatin, are piled on low trucks to a height of about six feet. From here they are rolled to the second unit of the tunnel system.

The second unit consists of three different series of long tunnels, each series having a different temperature range control. The first of the series, popularly called the cold tunnels, range from 10 to 38 degrees C., although they are usually operated at atmospheric temperature. The second of the series, or intermediate tunnels, can be varied in temperature from 30 to 50 degrees C. The third or hot tunnels have a range of 50 to 65 degrees C. The entire series is so arranged that the transfer of trucks from one tunnel to the next constitutes a progressive passage to the grinding equipment.

All tunnels of the second unit are directly connected to a high power blower with two large banks of steam coils interposed. The air feeding all blowers is filtered as previously described. The jellied sheets entering the cold tunnel contain from 95 to 97 per cent moisture. About nine hours are required to produce a hard film on the surface of the sheets. This condition must be reached before any heat can be applied. It is at this point where the

The dried gelatin is scraped off in long ribbons, and passes through an Abbe cutter directly into the barrels.

hazard of tunnel drying is experienced. If the humidity is high (summer) little evaporation takes place, and an increase of one or two degrees in temperature may cause the gelatin to melt and drop through the nets to the floor. In summer one has to be a climatologist to know if the day's run will hold up.

The trucks are placed in the tunnels in rows. Every hour or so one or two rows are transferred from the front of one tunnel to the rear of the next where

Frank R. Johnson, '18.

the temperature is increased. The trucks in the first tunnel are then moved forward. Thus, after from 15 to 30 hours, the gelatin has been moved progressively from the cold to the hot tunnel and has been dried to about 10 per cent moisture. The resulting sheets are thin, transparent, polished in appearance, and extremely brittle.

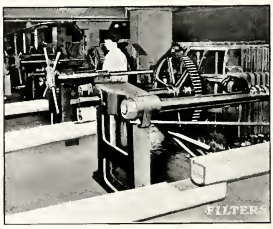
The third operation consists of crushing these sheets, possibly grinding and blending. Only in exceptional cases is an individual lot or run sold as such. Usually blends are made to produce a product having standard chemical characteristics.

The fan on each tunnel forces 40,000 cubic feet of air per minute over the gelatin in that tunnel. Assuming the efficiency of the air filters to be 98 per cent, and the statement of Frost and McCampbell to the effect that one bacterium dividing once hourly will produce if uninhibited about 17,000,000 individuals in 24 hours, it becomes apparent that bacteriological development is difficult to control. In fact, we have examined samples of gelatin on the market showing commonly 2,000,000 bacteria per gram of gelatin, and as high as 35,000,000 per gram. Every precaution to sterilize pipe lines and equipment does not reduce the bacterial count below a moderate number. For this reason it can be readily understood why new means of drying have been so industriously sought. The culmination of these efforts is the wheel process of drying.

The wheel is about 20 feet in diameter and has a 50-inch face. It is mounted on heavy concrete piers and the rim is encased, with exception of a few feet, by a monel metal duct through which a counter current of air is forced. The liquor to be dried is delivered to the pan "A" which rides on the face of the wheel. The rim of the wheel is a series of steam pads. These are supplied with steam through one side of the shaft and the condensate is exhausted through the opposite side. As the wheel revolves it picks up a uniform thickness of liquor and as the moisture is evaporated by the heat from the steam pads, it is rapidly removed by the filtered air in duct "B". This air requires no conditioning whatever. The wheel makes a revolution in 40 to 60 seconds depending on the nature and Baumé of the liquor. During this time the gelatin is dried and scraped off in long ribbons, by a series of knives, "C". These are run through an Abbe cutter and directly into a barrel. Gelatin dried in this manner has an exceedingly low bacterial count.

Gelatin can be produced from bones by heating them under pressure, yielding a low testing gelatin, or by treating with a dilute acid to dissolve the mineral matter leaving ossein from which a high testing product can be obtained.

The bones available for the manufacture of gelatin are cooked in the packing house for 8 to 14 hours at about 82 degrees C., or until all meat can be readily detached. They are then

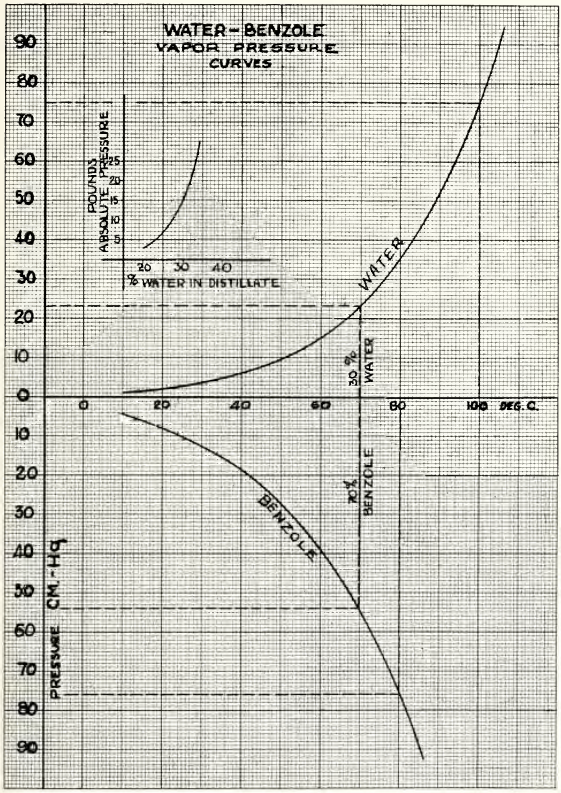


The filtering operation is largely facilitated by maintaining the proper degree of acidity.

washed, dried and shipped to the gelatin plant. This preliminary cooking hydrolyzes a small amount of collagen and renders a good part of the grease.

At the gelatin plant, the bones are unloaded into a rough crusher from

which they are conveyed to extractor tanks. Here the bones are dried sufficiently to expedite extraction of any grease. Removal of the moisture at the lowest temperature consistent with practical operation is very important because the rate of hydrolysis of the collagen increases rapidly as the temperature rises.



The proper temperature of the extractor is readily determined from vapor pressure curves.

The temperature in the extractor can be determined by application of the principle of steam distillation. The boiling point of two immiscible liquids is lower than the boiling point of either. To determine the temperature at which water and benzole will distil, it is only necessary to construct the vapor pressure curves of both as shown. Referring to the graph, to ascertain the temperature of the boiling point of the mixture at any pressure, say 76 cm, lay off an ordinate touching both curves, equal in length to the distance from 0 to 76. This cuts the abscissa at about 70 degrees C., indicating that a mixture of water and benzole will distil at 70. The proportion of each in the distillate is in relation to the distance above or below the abscissa divided by total distance between the curves. Since the primary object is to remove the water from the bone the question "At what pressure does the maximum water distil over?" is readily answered by the inserted curve.

When the moisture in the bones is reduced to between 5 and 8 per cent the grease will run about .5 per cent. The dried and degreased bone is milled and graded according to size. Most of the soft bone is separated from the hard. About three-quarter inch bone is the most satisfactory to acidulate. It is loaded in wooden tanks holding about 5,000 pounds, four of which constitute a battery. Dilute muriatic acid is circulated over the bone to dissolve out the mineral matter, in such a manner that it will be as completely spent as practical when it is discharged from the last tank in the battery. The time of acidulation is a function of the strength of acid used, the temperature, and the hardness of the bone.

When completely acidulated, the ossein, which is the organic substance of bone, is limed or washed, and cooked as described above.

The composition of the leach liquors resulting from the above acidulation varies considerably, depending on the conditions existing at the time of making. If the exact amount of acid is used the following reaction results,

$$Ca_3(PO_4)_2 + 4HCl \rightarrow CaH_4(PO_4)_2 + 2CaCl_2,$$

but if an excess of acid is used free phosphoric acid is formed,

$$Ca_3(PO_4)_2 + 6HCl \rightarrow 2H_3PO_4 + 3CaCl_2.$$

To determine the course of the reaction and thereby be enabled to control the rate of feeding the acid, the following check is made frequently. An indefinite quantity of liquor to be tested is diluted about half and half with water. A few drops of methyl orange are added and the solution is titrated with about normal (adjustment is not necessary) caustic soda solution. When the end point is reached the burette reading is noted. A few drops of phenolphthalein are now added to the same solution and the titration continued. The number of cubic centimeters of solution required by the methyl orange and the phenolphthalein give a ratio which has a definite significance. If the liquor consists entirely of phosphoric acid the ratio will be exactly 1 to 2. If the ratio is greater than 1 to 2, mono-calcium phosphate is present; and if the ratio is less than 1 to 2, free muriatic acid is present. Thus, if a ratio of 2 to 1 is obtained, the operator at once knows that he is feeding the acid too fast or is not diluting it properly.

To recover the mono-calcium phosphate, milk of lime is added until the reaction is barely acid, and agitation is continued for several hours. The

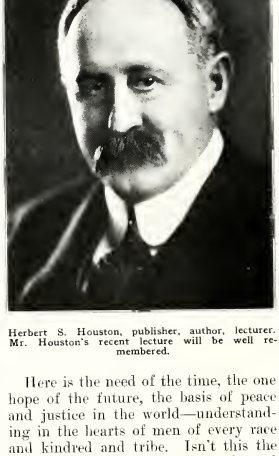
(Continued on page 70)

YOUTH AND THE NEW WORLD

By
HERBERT S. HOUSTON
Publisher of "Our World"

I WONDER if you have been reading, as I have, these fascinating reminiscences of the great physicist, Michael Pupin, in Scribner's. You will recall what an inspiriting picture he gives of the world-spanning influence of science that has gone out from Cambridge, from the days of one of her greatest sons, Isaac Newton. As I got that picture in focus it seemed to me that I could visibly behold the world growing smaller. No wonder that when Pupin went back to his home in Serbia his pious old mother would always talk of "the sacred men of Cambridge." And they were in fact sacred men, discovering the eternal laws of light and heat and sound and gravity—laws that have reshaped, almost remade, the world we live in. Out of these laws have come the amazing era of invention and modern industrial progress. Communication and inter-communication have come by telegraph and cable and in the air. The other day in New York President Thayer of the American Telegraph and Telephone Company sat in his office and talked with Marconi in London by wireless telephone. I shall not soon forget the thrills that swept over me a few months ago in St. Louis as I broadcasted a talk by radio out over this broad Mississippi Valley and far beyond the Rockies; the operator in charge, pointing to some light bulbs in the ceiling of the radio room, said quietly, "When those lights go red you'll know you've got the air and then you may begin." All as a matter of course—but a miracle none the less. In a moment I was talking about "What Europe Means to the Mississippi Valley" and, as I learned later, people beyond Pike's Peak sat in their homes and heard plainly every word I sent out over the air, to travel with the speed of light.

All of these marvelous inventions have come from principles and formulas discovered, in the main, in the universities. And every day as the students and research men, the sacred men of science, have worked in their laboratories, the world has been growing smaller. Today it is no larger than the globe bearing the maps of the sea and the land. It can be encircled in the twinkling of an eye. That is what this and all other schools and universities have been doing to the world. And behold the result! The world has been jammed together by modern invention and communication into all manner of relationships before it was spiritually ready for them. All of these things have meant trade and travel and relationship of a thousand kinds but they have not touched the spirit of men with understanding.



Herbert S. Houston, publisher, author, lecturer. Mr. Houston's recent lecture will be well remembered.

Here is the need of the time, the one hope of the future, the basis of peace and justice in the world—understanding in the hearts of men of every race and kindred and tribe. Isn't this the world's clear call to the schools and universities—for men and women, with the vision of service, who will promote understanding the world around? And it is cheering to see that you are heeding the call. The exchange of students and professors among the universities of many countries; your Cosmopolitan Clubs; your Y. M. and Y. W. C. A.'s, pointing to work in foreign fields; your broadening studies of the sciences and the humanities—all these enlarging activities show that you are realizing that the proper study of mankind is man and that service, as taught by the Divine Teacher of Nazareth, is the great law of life.

I spoke just now of the need of understanding in other countries, but I must say the same thing, with even greater emphasis, as to the need of understanding here in America of the rest of the world. This happens to be a subject to which I've given a great deal of personal thought and attention for years. After I had surveyed it and studied it and come to some knowledge of the length and breadth and thickness of our ignorance of other peoples, I was convinced that everyone should do something about it. As for myself, being a publisher, I started a magazine, in the hope that it might be a candle bearing a little light about the ideas and movements and peoples of the world. But there is work for everyone to do, if America is to come to know about the world. And it is tremendously important that we come to this knowledge, both in our interest and in the world's interest.

And when has this knowledge of the world been so vital as right now? The whole of Europe is in unstable equilibrium. There are many sound observers who believe civilization itself is at stake. New ideas are rife in the world. Russia is trying a vast experiment. Many new nations have come into being, children of the Versailles treaty. France and Germany are at daggers drawn in the Ruhr. The one thing that seems clear is that whatever affects any country affects all the others. This is the result of the shrinking of the world, to which I have already referred, due to the progress of invention and communication. Today nearly every important question that affects the world is international—exchange, reparations, allied debts, control of basic raw materials. No nation can settle these questions alone. They require international cooperation. In no other way can they be solved. Here is the unparallelled opportunity that calls to college students here at Armour Institute of Technology and in every other institution. You are in truth the heirs of all the ages. The great river of knowledge from which you have drunk has had flowing into it the stream of culture and discovery and research from all the world. You don't ask from what race or country knowledge comes—you ask only, is it true? In a real sense you have the international point of view. And what is even more important, you have the glorious faith of youth. So with the mighty inheritance of the past behind you, and with the pressing need of the present

(Continued on page 72)

DILUTION OF THE CRANK CASE OIL OF AUTOMOTIVE ENGINES

By

C. M. LARSON, '13

Supervising Engineer, Lubrication and Railway Sales Department, Sinclair Refining Company

IN the past two years much has been published about the dilution problem. The fuels of the present and the future are gradually becoming heavier and less volatile. Through the use of these heavy fuels in engines designed for the burning of lighter and more volatile fuels, we are confronted with an unbalanced condition of the fuel, the engine and the lubricating oil. The condition existed before, but due to the fact that the fuels in use did not contain so many heavy ends, the thinning of the lubricating oil was not so noticeable or troublesome.

Dilution of the crank case oil of an engine operating on these heavy fuels takes place through three phases. In the first instance, the vapors escaping past the piston rings during the compression stroke re-condense in the crank case; secondly, the film of lubricating oil on the cylinder walls, which has become diluted with the unvaporized fuel during the admission and compression strokes, drains back into the crank case; and thirdly, the lubricating oil is decomposed or "cracked" as it is thrown against the underside of the piston.

These conditions occur in all internal combustion engines operating with the present day fuels. The dilution varies in amount with different makes of engines and with different drivers, and is also somewhat dependent upon the weather, temperature, and upon the condition of the engine as to wear or fit of piston rings. With all makes and conditions of cars examinations at random show that the mixture of oil and fuel in the engines is much thinner than would ever be considered proper for the efficient lubrication of the motor.

In some cases dilution is due to the free use of the choker in starting and to the bad practice of washing the engine out with kerosene after draining the motor oil. This last practice will start a new filling of motor oil off with over 10 per cent of dilution, because it is often impossible to drain all the kerosene that remains in the pockets and baffles.

In order that the changes noted above may be more clearly portrayed Chart I is given. This graph is made from readings and samples taken from an Oakland car during a run of 1,100 miles. The record shows the typical operating conditions of the average engine and the usual procedure of the motorist.

The curves in Chart I are laid out on the basis of the distance covered in miles. Starting with the crank case filled with eight pints of new heavy motor oil, as shown by the indicated normal level line of the oil, samples were taken at regular intervals and new

Figure 1. The motorist may now tell definitely whether his oil needs renewing. This device is one of Mr. Larson's inventions.

make-up oil added as graphically represented at S1. At this stage of the run a pint sample was taken out and two pints put in, bringing the level of the oil in the crank case practically back to normal. The conditions under which the crank case oil was operating up to the time sample S1 was taken are represented in the middle section of Chart I by the curves of the temperatures of the air, of the water in the radiator, and of the temperature of the oil in the crank case above the temperature of the air, or the rise of temperature due to the heat of operation of the motor. The upper division of the graph shows the analyses of the oil samples and shows how the body of the new oil is reduced in viscosity as the percentage of dilution increases, also how the sediment, ash, and flash point change through operation.

The results of this road test show that it is very dangerous to allow the level of the oil in the crank case to get down too low, for it will be readily seen that at the time sample S6 was drawn there were only two pints of oil in the crank case. This oil had the body of a light spindle oil, being only 105″ at 100° F. (Saybolt Universal) whereas the flash point was only that of kerosene, namely 165° F. Then too the amount of sediment, which is a combination of oxidized oil, free carbon and road dust, was high.

Under conditions represented by sample S6, in the majority of cases bearings would have seized or the cylinder walls and rings would have been subject to excessive wear, in all probability resulting in scored cylinders because of the thinness of the oil and its contaminated condition. Some motorists have the idea that by allowing the crank case oil level to get very low, as in the above case, it is possible to bring back the lubricating qualities of the crank case oil by adding new make-up oil, as illustrated by the points S6, S7 and S8. This chart shows that the oil does not recover its lost characteristics, the total amount of sediment is still there, as well as the high dilution, which undesirable features are not found in the new oil. The conditions of every day operation are really worse than shown on this chart because by draining out the laboratory samples from this test engine, the percentage of make-up oil is greater than in actual practice.

In order to show how important a part dilution plays in the lubricating or frictional load placed on an engine, let us refer to Chart II, which represents the operation of a tractor engine using kerosene as fuel. For the first hour of operation the body of the oil was not materially affected by the leakage of the heavy ends of the fuel into the crank case oil and the power of the engine was not affected. But beyond this point there was a marked decrease

in power output, which fell from 28 B.H.P. to 25.75 B.H.P. in less than seven hours. At this final point the dilution was 38 per cent, and the viscosity of the crank case oil was reduced to the body of a very light spindle oil.

Knowing that dilution is detrimental and there is a point beyond which this thinning out of the crank case oil increases friction and causes excessive wear, the motorist should make it a point to either avail himself of "crank case service" being offered by garages and filling stations, or else take it upon himself to give this feature special consideration. It is true that there is no definite rule that can be laid down other than to drain every 500 to 800 miles. However, research along this line has developed instruments which are now offered the motorist whereby he can test out the life of his crank case oil as easily as he now does the condition of his storage battery and the air pressure in his tires. These instruments are based on two principles—one, percentage of dilution (Dilut-O-Meter), and the other, viscosity (Vis-Gage).

The Dilut-O-Meter, Figure 1, is simply an hydrometer, and like all such instruments depends for its readings on the density or specific gravity of the liquid being tested. In this case, however, the scale does not read in terms of Baumé gravity or specific gravity but in words which indicate the condition of the oil, this arrangement being made so that no interpretation of results is necessary and so that anyone who can read words of one syllable can be guided correctly.

The principle according to which the instrument operates is that as oil is diluted by fuel it becomes lighter. By running tests on various engines and with various oils, and distilling the used oils to determine the percentage of dilution and comparing these results with the specific gravities, the decrease in density corresponding to various amounts of dilution has been worked out and the scale graduated accordingly.

At the same time there is a wide variation in the density or specific gravity of lubricating oils when new, such that some oils when new are as light as others after they are diluted altogether too much to give satisfactory lubrication. This variation is taken care of by putting the indicating scale not directly on the stem of the instrument, but on a sliding sleeve which may be moved up or down. The instrument may be set by putting it in the new oil and moving the scale to the zero point, or it may be set from tables furnished by the makers of the instrument showing the proper scale settings for the well known oils.

The principle of the Visgage (Figure 2) is that the travel of spheres through two oils is dependent upon their relative viscosities. Therefore if we have two parallel inclined tubes of the same size containing the same oil and at the same temperature, two small spheres will reach the bottom of the incline at the same moment. However, if one oil was twice as viscous as the other, the sphere in the heavier oil would be only half the way down the incline when the sphere in the lighter oil had reached the bottom. Thus if the viscosity of

(Continued on page 63)

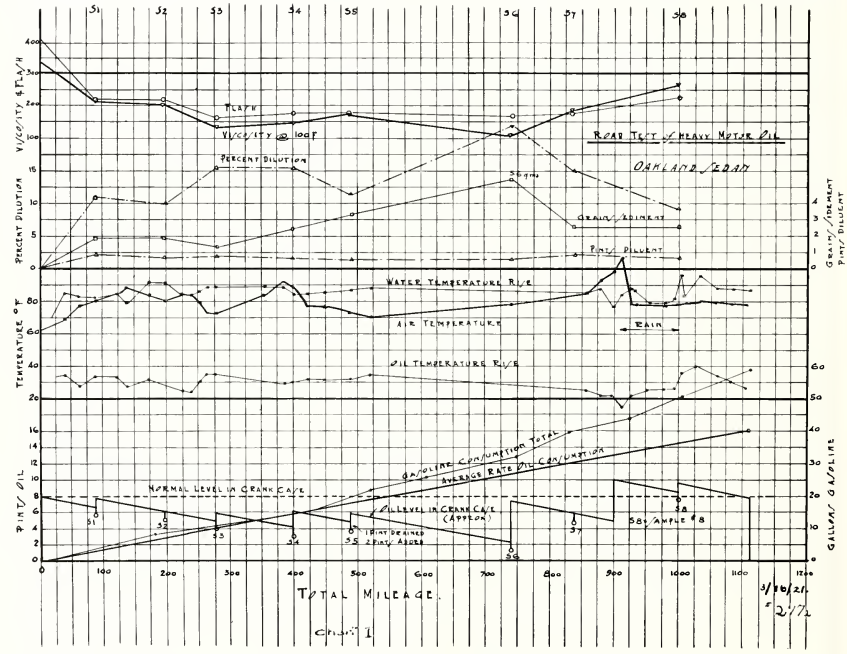


Chart I. Comprehensive results of a road test of motor oil.

THE GRADING OF COLLEGE STUDENTS

PART 2

By

H. R. PHALEN

Associate Professor of Mathematics

IN the portion of this article which appeared in the November issue it was pointed out that under the present method of operating the American college any really scientific approach to the problem of grading was impossible for two reasons namely,

(1) The labor involved in collecting and arranging the data is prohibitive.

(2) The sources of data are not equally reliable. As a matter of general interest the writer then proceeded to show some of the mathematical computation underlying reason (1) above. In that connection it was noted that in order to study the relation between class grades and final examination grades it would be necessary to compute the "coefficient of correlation."

The correlation coefficient is the measure of the dependence of one set of variables upon another. In the present instance the class or quiz grades constitute one set of variables and the examination grades make up the other set. Mathematically the definition of the coefficient of correlation is expressed in the form,

$$r = \frac{p}{\sigma_x \cdot \sigma_y} \qquad (15)$$

where if x and y are the several deviations from the means of rows and columns respectively we have the following definitions,

$$p = \frac{1}{N}\Sigma xy, \qquad (16)$$

$$\sigma_x^2 = \frac{1}{N}\Sigma x^2, \qquad (17)$$

$$\sigma_y^2 = \frac{1}{N}\Sigma y^2. \qquad (18)$$

Table II

Examinations

Quizzes	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	81–85	86–90	91–95	96–100
41–45	5			1	1							
46–50	1	1	1	2		2						
51–55	5		1		3							
56–60	2	1	2		1	1						
61–65	5	2	2	4	2	1		1	2	2		
66–70	4	11	7	6	5	9	4	5	1	3	1	
71–75	5	6	8	7	7	9	12	5	6	3	8	
76–80	5	4	5	2	20	15	10	15	9	12	6	4
81–85	6	3	2	6	10	7	15	13	12	9	14	5
86–90	3	2	3	4	5	6	5	11	14	15	9	7
91–95					2	2	3	1	4	9	18	7
96–100						1		1	4		5	2

The interested reader may find a very excellent semi-popular discussion of the whole subject in Chapter IX of "An Introduction to the Theory of Statistics," by G. U. Yule.

In Table II the twelve horizontal entries at the top give the final examination grades in five point intervals; the twelve vertical entries at the left give the quiz grades, also in five point intervals. In the body of the table are assembled the frequencies of an aggregate of 535 students. A casual observation shows that there is a general drift of large frequencies from the upper left hand corner to the lower right hand corner, and such a drift it has been shown, leads to the supposition that the data satisfies the requirements for Gaussian surface.

In order to understand the table it might be noted that the entry "11" in the second column means that eleven students who obtained quiz marks between 66-70 received grades from 46-50 in the final. The entry "14" in the ninth column means that there were fourteen who got quiz grades in the interval 86-90 and examination grades in the interval 81-85.

Determination of the Correlation Coefficient

The first step in the determination of the correlation coefficient is to obtain the means of the rows and columns. This may be done most easily by numbering the rows and columns from 1 to 12 and thus escaping the use of the percentage numbers.

To find the mean "X" of the first row we multiply the frequencies by their respective column number and

Table III

X	Y	x Dev. from mean X	y Dev. from mean Y	x^2	y^2	Products xy +	Products xy −
2.00	5.80	−3.71	−2.17	13.76	4.71	7.85	
3.71	6.76	−2.00	−1.21	4.00	1.46	2.42	
2.56	6.74	−3.15	−1.23	9.92	1.51	3.87	
3.00	6.87	−2.71	−1.10	7.34	1.21	2.98	
4.00	7.58	−1.71	−0.39	2.92	0.15	0.67	
4.87	7.68	−0.84	−0.29	0.71	0.08	0.24	
5.98	8.28	+0.27	+0.31	0.07	0.10	0.08	
6.83	8.46	+1.12	+0.49	1.25	0.24	0.56	
7.40	8.96	+1.69	+0.99	2.86	0.98	1.67	
8.04	8.96	+2.33	+0.99	5.43	0.98	2.31	
10.20	9.57	+4.49	+1.60	20.16	2.56	7.18	
9.98	9.92	+4.27	+1.95	18.23	3.80	8.33	
Mean = 68.57/12 = 5.71		Mean = 95.58/12 = 7.97		86.65 Mean = 7.22	17.78 Mean = 1.48	Σ xy = 38.16 Mean = 3.18	

For the purpose of this article, however, the writer will consider a table of data collected from his own classes at Armour Institute of Technology during the last five years, and will endeavor by means of a detailed explanation of this table to bring out the significance of the correlation coefficient.

divide by the sum of frequencies. For the first row the computation gives

$$X=\frac{5\times1+1\times4+1\times5}{7}=\frac{14}{7}=2.$$

For the third row we get

$$X=\frac{5\times1+1\times3+3\times5}{9}=2.56.$$

Similarly for the last column we get,

$$Y=\frac{4\times8+5\times9+7\times10+7\times11+2\times12}{25}$$
$$=9.92.$$

A graphical summary of the complete determination is given in Figure 6 where the crosses indicate means of rows and the circles indicate means of columns. It will be noted that each set of means approximate a straight line. The line determined by the crosses (i. e. means of rows) has the equation

$$x=r\frac{\sigma_x}{\sigma_y}y, \qquad (19)$$

and the line determined by the circles (i. e. means of columns) has the equation

$$y=r\frac{\sigma_y}{\sigma_x}x. \qquad (20)$$

Evidently these two lines bear a relation to each other. That relation when found and expressed as decimal is the coefficient of correlation. It lies between -1 and $+1$. When $r=\pm1$ the circles and crosses lie on the same line and the relation is absolute; if $r=0$ the data shows no evidence of dependence.

In Table III appears in the first two columns headed X and Y the data al-

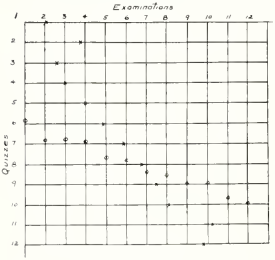


Figure 6. The crosses indicate means of rows (X), and the circles indicate means of columns (Y).

ready exhibited in Figure 6; in the third and fourth columns appear the deviations x and y. The mean of column X is 5.71. Compare this with the first entry 2.00 and we get -3.71 which is the first entry in column X.

Columns 5 and 6 are the squares, as indicated, of columns 3 and 4. Columns 7 and 8 are the products xy. Column 8 has no entries since all the products were positive.

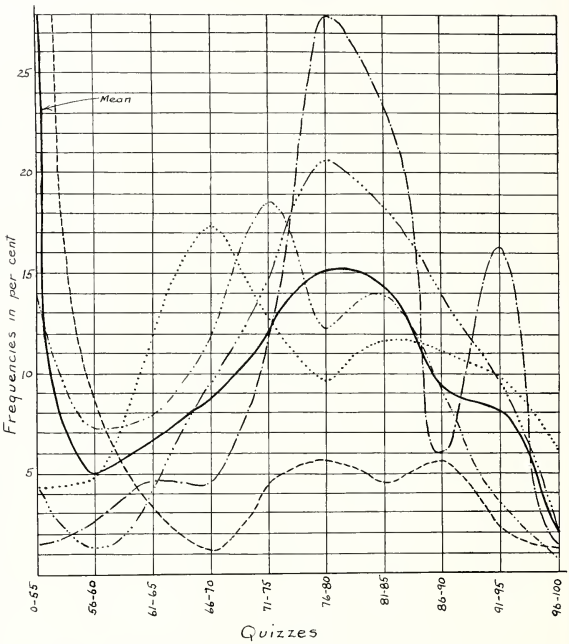


Figure 7. Individual frequency curves of instructors in Calculus I. Data from Table IV.

The mean of the x^2 is 7.22 and the mean of the y^2 is 1.48. Consequently, referring to equations (17) and (18) we get

$$\sigma_x^2=7.22;\quad \sigma_y^2=1.48;$$
$$\sigma_x=2.67;\quad \sigma_y=1.21.$$

Also the mean product p from (16) is

$$P=\frac{1}{N}\Sigma xy=\frac{38.16}{12}=3.18$$

From (15) we have

$$r=\frac{3.18}{2.67\times1.21}=.984$$

which is the coefficient of correlation for this particular set of data.

The significance of the result is that out of a thousand students nine hundred and eighty-four could reasonably expect their final examination mark to fall into the same five point interval as their quiz mark provided they were in a class conducted by the author. Each professor would have a different correlation coefficient depending not only upon himself but also upon the general run of his classes. An instructor in mathematics who had a majority of students taking Trigonometry would find that the correlation coefficient obtained from such classes varied quite perceptibly from the one computed from sections taking Calculus or Differential Equations.

The correlation coefficient, if properly computed and properly interpreted, is supposed to serve as a measure of the dependence of any two variables. Its determination is so complicated and laborious as to make its frequent use prohibitive, but certainly the following is true: if any teacher computed his correlation coefficient on each year's grades for a series of three or four years and found that it was consistently low, say around .500, he ought to take account of stock and determine whether his quizzes were too easy or his final examinations too hard.

There ought, at this point, to be sounded a warning against the trend that has set in during the last few years of the proper kind. One may put acorns through a flour mill but the result isn't flour.

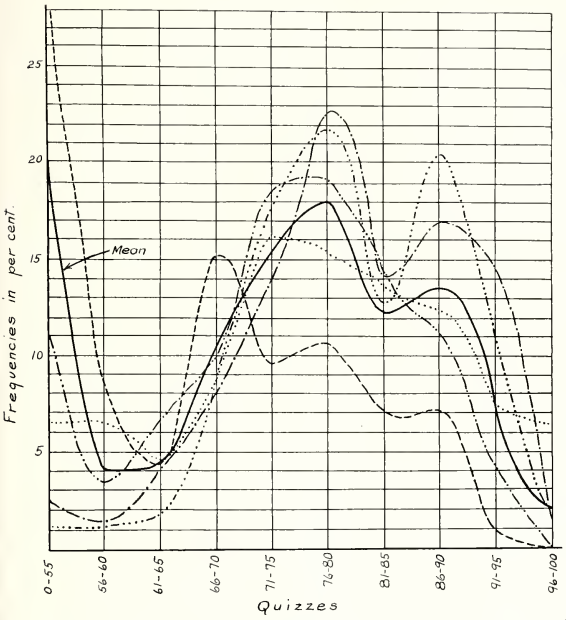


Figure 8. Individual frequency curves of instructors in College Algebra. Data from Table V.

among certain schools of education regarding statistical work. Some individuals with large ambition and small knowledge of mathematics have caught onto the idea of a correlation coefficient and have tried to make it an all powerful god in the field of pedagogics. There are many ludicrous instances where reams of paper have been used in collecting data from which with great pains a coefficient of correlation has has been computed to three or four decimal places. On the basis of the result obtained school boards, principals, and teachers, all over a county or a state, have been instructed that to deviate from the holy coefficient meant educational folly. The point to the whole fiasco is that in many instances the original data exhibited none of the properties of a Gaussian distribution. Any investigator may collect any statistics he pleases. He may put it into the Gauss machine and he will get a number, but the result doesn't mean anything unless the original data was

The writer collected information regarding the weights of the students in his classes and the months in which they were born. This is most obviously a non-Gaussian distribution, but nevertheless the means of rows and columns were determined, and by carrying the process through, the number of .69? was obtained. Some of our educational statisticians would be pleased to call this the coefficient of correlation, and upon that basis would very likely recommend that all boys in excess of 69? to the thousand, who weighed more than they should, ought to be sent to the state hospital. No doubt they could get some legislatures to appropriate a few hundred thousand dollars to complete the investigation. This may seem overdrawn, but the fact remains that a certain city of some hundreds of thousands of population spent a goodly sum to be informed that the correlation coefficient relative to the effect of diphtheria epidemic upon public health was 1+. In other words public health is improved by an epidemic of diphtheria. Remarkable isn't it?

Discrepancies in Grading

To the writer's way of thinking the outstanding difficulty with the present system is the utter impossibility of getting teachers to grade alike. The mere fact that they are human precludes it. The very thing that the students admire in a teacher—personality—renders him different from all the other instructors and hence makes it useless for him to try to mark his papers like the others.

In the paragraphs which follow an attempt has been made to show these individualities more in detail as they apply to the department of mathematics. What is true there, is true to a somewhat varying degree throughout the whole faculty—or any faculty for that matter.

The mathematics department in any engineering school is universally the one which the student body cites as the example of all that is horrible. Mathematics teachers must on account of their jobs, be utterly devoid of souls, totally ignorant of the milk of human kindness, and all in all, more or less mentally abnormal. One student confided to the writer that he had it upon good authority that every time an E was written on the office records the whole department held a war dance and grand pow-wow to celebrate the demise of another victim.

This state of mind is largely due to the following facts.

(a) The student encounters mathematics as one of his first collegiate experiences.

(b) He is not adjusted, and in many instances does not do himself justice.

(c) It is his first experience with rigorous reasoning.

(d) It is his first experience with the lecture method of instruction.

(e) In many cases he has gone through high school easily, and has been misinformed regarding the amount of mathematical knowledge he possesses.

(f) A large percentage of freshmen ought never to try to be engineers. They are temperamentally and mentally unqualified.

With all these factors at work the proportion of failures in mathematics is considerable and will so continue as long as any attempt is made to maintain even decent logical ability. The department of mathematics is, and is so recognized, as the clearing house for all the rest of the institution. It is

perhaps true that in a few isolated instances good chemists or good architects, or possibly good preachers or politicians, may have been prevented by the mathematics department from completing a college career. In general, however, that is the place where those individuals are discovered who refuse to work, and a man who refuses to work won't succeed at anything. Such a student would reflect but small credit upon any department, even were he permitted to go on without mathematics.

If, instead of crediting student gossip, we turn our attention to the actual class records, we unearth some rather interesting facts. In making his investigation the writer chose one typically freshman subject and one typically sophomore subject. In Table IV we have listed the quiz marks in 5 per cent intervals, excepting the first one which is 0-55. In the next line appears the department average per cent, and below follow in order the percentages for the five members of the teaching force. The data extends over a period of four years and hence is but slightly affected by the fluctuation of a single semester. It is true, however, that certain men have taught Calculus rather consistently during the second or "off semester." Such classes usually contain a considerable per cent of men who failed the first semester. To aid in understanding the table it may be noted that "Professor One" for instance had four and three-tenths per cent of his students below 55, one and one-half per cent were between 56 and 60, four and three-tenths per cent were in the interval 61-65 and so on.

At the extreme right end of the table under the headings, A, B, C, E, appear the percentages of grade marks as they were finally turned in to the office.

It is interesting to note that the percentages of those getting C are unusually uniform.

In Table V, College Algebra, the arrangement is the same as in Table IV. Here we find a lower percentage of A's and a higher percentage of E's. That is natural. In a Calculus class the inefficient freshman have been weeded out—some of the students have begun to learn how to concentrate and the tone of the class is better all around.

One could comment at great length upon the features of the data but the outstanding points are most readily noted from a graph. Figures 7 and 8 are drawn from Tables IV and V respectively.

The graphs exhibit individuality in the grading of quizzes which at first sight appears excessive, but a careful examination will show that for all intervals except 0-55 the maximum departure from the mean is thirteen per cent which is the curve of "Professor Five" in the subject of Calculus. Outside of that isolated instance the maximum departure is eight per cent.

The curve of "Professor Four" shows some interesting facts. His low marks are excessive and his high marks rare. Nevertheless his percentage of A's, it will be observed, is the highest in Calculus, is not lowest in Algebra, and in percentage of E's he stands about midway.

One thing is shown conclusively and that is that one man is about as good a gamble as another for the student who feels that way about mathematics. The instructors in Tables IV and V are not listed according to rank, age, or length of service, and consequently the readers of this article may amuse themselves if they so desire by conjecturing as to which set of percentages belongs to each professor. From scraps of conversation which the writer has overheard he is quite certain that many students will guess very wide of the mark.

When once past the mathematics department all troubles are over. So say some Armour men. Table VI which covers eight subjects was computed on the basis of approximately 500 marks in each subject. Consequently no one class and no one instructor can bear the burden of the results.

The outstanding features are

(a) Descriptive geometry recitations head the list in failures.

(Continued on page 77)

Table IV

Calculus I—Quizzes

	0–55	56–60	61–65	66–70	71–75	76–80	81–85	86–90	91–95	96–100	A	B	C	E
Department Percentage	**34.5**	**5.1**	**6.9**	**8.9**	**12.2**	**15.2**	**14.5**	**9.1**	**8.3**	**2.2**	**6.1**	**16.5**	**52.0**	**21.3**
Prof. One	4.3	1.5	4.3	9.7	15.0	20.8	18.3	14.0	9.7	2.4	6.6	20.8	47.4	25.1
Prof. Two	14.0	7.5	8.0	12.1	18.7	12.1	14.0	8.0	3.7	0.9	2.3	13.6	50.0	34.1
Prof. Three	4.3	4.9	11.6	17.2	12.8	9.8	11.6	11.0	9.8	6.1	8.5	16.5	47.7	27.3
Prof. Four	63.0	8.9	3.3	1.1	4.5	5.6	4.5	5.6	2.2	1.1	9.4	12.2	55.2	23.3
Prof. Five	1.47	2.9	4.4	4.4	11.8	28.0	23.5	5.9	16.3	1.5	3.9	19.5	59.7	16.9

Table V

College Algebra—Quizzes

	0–55	56–60	61–65	66–70	71–75	76–80	81–85	86–90	91–95	96–100	A	B	C	E
Department Percentage	**20.3**	**4.3**	**4.4**	**10.4**	**15.4**	**18.1**	**12.5**	**13.8**	**7.7**	**1.9**	**5.0**	**18.0**	**51.1**	**25.9**
Prof. One	1.2	1.2	1.8	9.4	18.2	21.8	12.9	20.6	11.2	1.8	3.4	28.2	48.3	20.1
Prof. Two	6.6	6.6	4.8	9.0	16.2	15.6	13.8	12.6	7.8	6.6	7.2	19.2	41.9	31.7
Prof. Three	11.7	3.5	6.7	10.1	18.7	19.1	14.5	11.3	4.3	0	2.4	12.7	55.4	29.8
Prof. Four	35.1	9.0	4.5	15.3	9.9	10.8	7.2	7.2	0.9	0	2.9	9.5	63.8	23.8
Prof. Five	2.9	1.4	4.3	8.5	14.3	22.9	14.3	17.1	14.3	1.4	9.2	20.4	46.1	24.3

(b) The graphs of Figures 7 and 8 show that the curves of the instructors are more irregular than the curves of the students.

(c) The curves of the instructors are more irregular than the curves of the students.

(d) The curves of the instructors are more irregular than the curves of the students.

(e) The curves of the instructors are more irregular than the curves of the students.

(f) The curves of the instructors are more irregular than the curves of the students.

(g) The curves of the instructors are more irregular than the curves of the students.

(h) The curves of the instructors are more irregular than the curves of the students.

(i) The curves of the instructors are more irregular than the curves of the students.

(j) The curves of the instructors are more irregular than the curves of the students.

Table VI

	A	B	C	E
College Algebra	5.0	18.0	51.1	25.9
Calculus I	6.1	16.5	52.0	21.3
Descriptive Geometry	13.3	39.8	15.9	31.0
Qualitative Analysis	12.1	27.2	37.3	23.4
English I, II	10.3	39.8	42.0	7.9
Mechanics I	11.5	43.0	37.9	7.6
Physics I	6.1	27.8	49.2	16.9
Kinematics	21.4	29.1	29.8	19.7

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

In previous issues of THE ARMOUR ENGINEER, we have expressed an interest in the various activities, outside of pure engineering in which Armour men engage after leaving college. We have been able to tell our readers something of the accomplishments of our alumni in other fields of work, and shall be glad to continue whenever we can secure the necessary data. Graduates and former students of A. I. T. can assist materially in making this section of greater interest to us all if they will send in any information they may have relative to the "doings" of Armour men.

At this time we are able to present an interesting article from **Mr. H. G. Zuckerman, '04,** on "Engineering Training for the Farmer." In gatherings of Armour men the writer has often heard Herb. Zuckerman referred to as the Onion King, but it will be noted from the following article that onions are not his only product, nor indeed, his chief one.

Students of twenty years ago, and many members of the faculty remember Mr. Zuckerman well, although it has been years since he has been seen at the Institute. He was active in all student activities during his undergraduate days, particularly the *Radical X Club* and the *Chemical Engineering Society*, not to mention "The Walking Delegate," of which he was manager. Everyone in college knew Herb. Zuckerman; he had that kind of a personality. No doubt these qualities have contributed to his business success, which we are pleased to record.

ENGINEERING TRAINING FOR THE FARMER

By H. G. Zuckerman, '04

Gordon Wilson's article in the November ARMOUR "ENGINEER," "Technical Training as Basis for Business Career," inspires me to take my pen in hand to present the following:

Firstly, Gordon describes me (Herb. Zuckerman) as having risen to a point where I am now one of the biggest dealers in onions on the Pacific Coast. Onions are only a side line. My real activity is farming. My two brothers and myself are the proud owners of an island in the Delta of the San Joaquin River of California, near the city of Stockton, where we have 2700 acres of land, all under cultivation, principally to the crops of potatoes and onions. During the last eight years we have gone through failures and triumphs that face all big farming enterprises.

The concentrated result of experience gained shows clearly the necessity of engineering training to the farmer, and if anyone does not classify farming as a natural outlet for engineering ability and training it is only because of ignorance of the farmers' problems and opportunities, and because of the classification that society has incorrectly given for ages to this most important human activity. Judging by the mentality of the average farmer this indictment has been correct, but we are now at the turning point and society will soon recognize that the "engineer" on the farm is just as necessary as the civil engineer to the railroad, the chemical engineer to the cement plant, the electrical engineer to the motor manufacturer, and so forth. The successful farmer of the future, get it where he can, must have the training that only an engineering course will give him. The important fact exists that the present engineering courses do not go far enough to round out entirely the knowledge and training that a competent modern farmer must have. The present courses offered in the many agricultural colleges are inadequate, superficial, and I feel justified in saying are almost a waste of time as far as equipping a man to meet actual problems facing the farmer.

From a strictly scientific viewpoint the farming industry of the world is in the same relative position that medicine was at the time of the Greeks and Romans. There has been just about as much progress made in agricultural developments to the present time as had been made in medicine at the time of Plato. Broadly speaking there has been absolutely no relation established between scientific theory and field practice in soil chemistry, soil preparation, soil fertilization, seed selection, soil bacteriology, plant pathology, plant physiology, and so forth. Every one of these, together with a great many others is most important in the every day life of the farmer and the correct solution eventually determines the profit and loss. There is a lot of camouflage handed out by the agricultural colleges but their whole endeavor is to approach the subject from the top and not from a study of essential facts based on accurate scientific knowledge. For instance, Fertilization: The fertilizer industry of the United States represents millions of dollars of capital tied up in equipment and materials. There is not a man living today that can correctly and accurately tell a farmer what fertilizer to apply, when to apply it and how much to apply. There is a lot of trade talk disseminated, but when you sit across the desk from the fertilizer salesman, the fertilizer plant manager or agricultural college professor, specializing in fertilization, if such can be found, for they are rare birds, there is not one but who would quickly admit that he has absolutely no definite knowledge to work on. All fertilization is done in a hit and miss manner, and with no scientific or engineering basis.

This year in our farming operations we are spending $35,000 on fertilizer, but for all we know $20,000 might be sufficient, or $70,000 might better be the amount. We guess at what we ought to use, based on rough measurements of past results, but there are no scientific refinements possible. Here is an excellent opportunity for the correctly trained chemical engineer. The coming generations of chemical engineers, with proper underlying scientific training, can save society millions of dollars yearly, and increase the production of the soil immeasurably.

(Continued on page 60)

THE START OF ANOTHER DAY

It is 6:30 A. M. of the shortest day in the year. A heavy fog has come in from the lake, driven by a northeast wind and accompanied by a drizzling rain. The arc lamp at the corner of Thirty-third and Federal Sts. penetrates the darkness far enough to disclose the bulky figure of a man approaching from the south in Federal St. As he reaches the main building of the Institute he leaves the sidewalk and enters through the small south door into the boiler room.

His experienced eye takes in at a glance gauge glass, pressure gauge, and flow meter. With a "Good morning, Gus," to the fireman, Chief Engineer Allen steps into the engine room, guided by touch and sense of location. He prepares to start the engine and turn on the lights so that the day's work can begin.

In the meantime a Buick roadster has approached from the east in Thirty-third St., unseen in the early morning darkness, but not unheard. It draws up to the curb at the north end of the main building and a man of amazing length uncoils from beneath the steering wheel and steps out on the sidewalk. Professor Huntly steps inside, and without stopping at the door of his own laboratory, makes his way through the darkness towards the engine room. Already the hum of the engine can be heard, and just as the professor reaches the door, the click of the switches is heard as Engineer Allen throws on the "juice." The lights are on, and the day's work can begin.

Professor Huntly sits down with Mr. Allen at the latter's desk and looks over the morning paper. Later, about 8:30 or 9 o'clock, when his associates arrive, he will explain that he has already accomplished a half day's work. For some time there is comparative quiet in the engine room, broken only by the hum of the machinery.

Outside the daylight is coming slowly; the fog is thick and it is still raining. Occasionally an "early bird" student appears on Thirty-third St. hoping to solve that last problem in mathematics or finish an over-due mech. lab. report before 8:30. A Haynes touring car approaches slowly, the driver picking his way carefully among the mud puddles. The wheels of industry are due to start very soon in the chemical department for it is "Albert Edward" Dean, crown prince of the third floor.

Gradually the streets are filling with students, hurrying along for 8:30 classes. In the street students in flivvers and students in automobiles. On the sidewalks a steady stream of students from surface cars, elevated, and the fraternity houses on Michigan Ave. There are overcoats with up-turned collars, sheep-skin coats, slickers, but no umbrellas; text books under arms, tee squares, brief cases. It is a good-natured, hurrying throng, oblivious of the rain and intent only on reaching the class room before Professor Campbell calls the roll or Professor Moreton shuts the door.

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THE ARMOUR ALUMNUS

(Continued from page 59)

thereby lowering the cost of production on the all necessary food supply. At the present time there is absolutely no correlation between laboratory analysis of the soil and what makes the plant grow. Until this is determined we are in the dark. It is possible to depict this same absence of knowledge in every other farming activity. Seed selection is almost embryonic in its present scope. Plant pathology with its necessary control of diseases has only scratched the surface. Plant physiology is most important in the treatment of the growing plant, but we are in the dark again. Almost nothing has been done on soil bacteriology, and nothing in field practice.

The solution of many of these problems will be made by the same methods that have made electrical engineering an exact science. The scientific fundamentals must be determined and then their application made in actual field practice. In the past the whole endeavor has been from the field because of lack of proper fundamentals and theory.

At the present time a "farm engineer" would have to go to many colleges to get the proper training. Theoretical chemistry, physics, surveying, and applied mechanics, should be obtained in technical engineering colleges. Botany, plant pathology, and plant physiology should be obtained I don't know where, but I do know the superficial courses offered in agricultural colleges are not sufficient, as the courses are not based on scientific facts which are obtained as result of theoretical training. For soil bacteriology you will probably have to go to the schools of medicine. Law, accounting and salesmanship are all very important and would have to be obtained from our classical universities.

The technical colleges are the proper mediums to fill the demand for a well-rounded "farm engineer" because the same requirements exist in farming that exist in all engineering lines, and only the well trained engineer can deliver the goods. The justification for the technical colleges to undertake this gigantic work is quite apparent when consideration is given the deplorable financial condition of the farming industry of the United States. Practically all food commodities are being sold below the cost of production, newspapers and the optimistic financial articles to the contrary. The cost of production can only be lowered by a solution of many of the problems that I have here briefly indicated, and this can only be done by a competent "farm engineer." In our own work we have applied many of the principles that we know to be correct and have been financially successful, but our experience has shown clearly the necessity for a wide-spread co-operative movement between the "engineer" and the real dirt farmer.

To anyone interested I will be glad to go into greater detail and a cordial invitation is extended to all Armourites, Alumni and Faculty who come to California to visit me. I will promise to show one of California's most interesting modern machine run farms, "ranch" we call them. The climate is fine.

C. L. Ott, '16, is secretary-treasurer of the American Grinding Co., Detroit. In collaboration with his father, Mr. A. J. Ott, who is president of the company, he has prepared an article on gear grinding which appeared in the November 1923 issue of *The Journal of the Society of Automotive Engineers.*

In their plant in Detroit they have developed a machine for accurately finishing automobile transmission gears after they have been heat-treated. Mr. Ott states that their machine will produce such gears on a production basis, with correct tooth-contour, smooth finish, and accurate tooth-spacing, all very important in interchangeable gears which must run quietly. The machine is of the generating type, its action being the same as if the gear to be finished were rolled along an imaginary rack, one tooth of which does the grinding.

The gear is mounted on the work-spindle, and the generating movement is provided by steel bands which wind and unwind on a pitch-diameter segment, as the work-carriage is driven forward and backward. In this way absolute duplication of tooth-contour and tooth-spacing can be accomplished. Variations in tooth contour can be secured, if desired, by varying the angle of the cutting wheel, or the diameter of the pitch-circle segment.

Mr. Ott states that very economical production of transmission gears is possible by first roughing-out the teeth to about 0.005 inch oversize tooth thickness, then heat-treating them, and finally grinding to the exact size and shape desired. In this way the warping which takes place in the heat-treatment is corrected, and an accurate, quiet-running gear produced.

In the December number of *The Armour Magazine*, published by Armour and Company, we note a brief article relative to an instrument which has just been invented to determine accurately the amount of butter fat in milk or cream. The inventors are George S. Dobbie and **Oscar A. Anderson,** both employees of Armour and Company. Mr. Anderson is an alumnus of the Institute, where he completed the course in mechanical engineering in 1915. His classmates and others who were students at that time will remember him as a quiet, efficient young man, much above the average as a student.

Soon after his graduation, Mr. Anderson joined the motive power department of Armour and Company, where he is now mechanical engineer. He has been active in the affairs of the American Society of Mechanical Engineers, having served as chairman of the membership committee of the Chicago Section. He has increased his acquaintance in this work very greatly, an important consideration in connection with all society work.

John R. LeValy, '16, was a caller at the Institute recently. "Jack," as he was known to all his associates during his student days, is making rapid strides in a business way. He is district manager for The Superheater Company, having his headquarters in Pittsburgh. He has charge of sales work, and he finds that an engineering training is extremely valuable to the salesman and sales manager, particularly when he is handling a line of mechanical equipment.

Fred P. Strauch, '16, has resigned his position as field superintendent for the Universal Oil Products Co., and is now with the Celite Products Co. The latter concern puts out a line of heat-insulating materials for covering boilers, pipe lines, and so forth. A very large field for such materials is found in the oil refinery, so that Mr. Strauch's experience in the oil business will be of great value to him in his new position. He will be manager of the Kansas City branch office, having charge of sales in that territory. He will reside at 2817 Linwood Boulevard, Kansas City.

Fred A. Manske, '23, has left the John R. Moore Co., Engineers, and is now with the United States Gypsum Co. This makes one more in the large group of Armour men with the Gypsum Co.

The last alumni luncheon before the Christmas holidays was held Tuesday, Dec. 18, at the Hamilton Club. About forty-five men attended, and judging from the interest taken and the pleasure which all expressed in meeting each other, these gatherings are well worth while.

Beginning with Jan. 8, a luncheon will be held every Tuesday of the month at the Hamilton Club. If these weekly affairs prove a success, it is quite probable that they will be continued throughout the winter. The writer and others are frequently asked when these luncheons are held, because when they occur only once or twice a month the dates are easily confused. But if we meet every Tuesday at 12:15 P. M. at the Hamilton Club, no one need make a mistake abont the date. It is hoped that the luncheons during January will be well attended, so that the officers of the association will feel encouraged to continue them every week during the winter season.

A. C. Lill, '13, has changed from civil engineer to salesmanship as a profession. He has had experience along this line as Chicago representative for the Illinois Commerce Commission, as a syndicate salesman for the Westinghouse Electric and Manufacturing Company, and as salesman for the Corporation Securities Company. Mr. Lill has made a thorough study of the art of selling, and has met with more than average success. His activities now are devoted chiefly to assisting others in overcoming sales problems, in which work he serves in the capacity of Salesmanship Counselor. This is no doubt an interesting and lucrative profession, and we are pleased to hear of Mr. Lill's success.

E. F. Dhus, '22, is no longer a chemist with Wilson and Company. He is now with the Automatic Electric Company, 1001 W. Van Buren St., Chicago, where he is engaged in production work. From chemist to production engineer may seem like a long step, but Armour men are "stepping out" like that every day. Long steps are much better than high ones; with the latter one runs too long in the same place.

Spencer Havlick, '21, now located in Pittsburgh writes in part as follows: "I have had the good fortune to meet several Armour alumni while in this district. I see James Watt, '22, often, and ran into Al. Edwards, '21, a few weeks ago. Al. is with the United States Gypsum Company, operating out of Erie, Pa."

F. A. Trask, '19, was in Chicago a few weeks ago. He is now with the Oklahoma Inspection Bureau, at Oklahoma City, in the capacity of sprinkler and foamite engineer.

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EDITORIALS

THE AWARD OF THE "A"

To labor under unavoidable handicaps and to produce few results may be excusable; but to overcome these handicaps at no little sacrifice, and then not to reap the full benefits therefrom is certainly regrettable.

Last year the student body taxed itself to provide a fund principally for the purpose of fostering athletics. Tennis courts were built, track, tennis, golf, swimming, boxing, and wrestling teams, were started under the direction of duly appointed coaches—and the men turned out in excellent fashion.

Letters were awarded in many sports, *yet only those men who won the "A" in basketball were awarded the honor publicly.* The others received their sweaters by "correspondence," during the summer. If it were not for an occasional cold day, when a sweater has its practical value as well as honor, we would never suspect that "the fellow next to us in Calc," is a Campus celebrity.

The only excuse that has been put forth is that there is not enough time at the end of the year to permit the award of letters for spring athletics, and as poor excuses go this is about the lamest one that we have heard. If we can't take an hour off, sometime during the last of the year, in which to honor our athletes then how on earth can these men find time to train throughout the entire year?

The whole matter can be set straight readily:

Be it resolved that:

A rousing Pep Meeting should be arranged, with all the "A" men of last year, *present, and on the stage*, where we can let them know that we are backing them to a man, and that we are expecting them to come through again this year, and,

Be it further resolved that:

All men winning the "A" in the future should be awarded the letter publicly during the school year in which they earn the honor.

THE IMPROVEMENT OF ENGINEERING EDUCATION

There seems to be at the present time a great deal of agitation relative to what is felt to be the inadequacy of engineering education. Engineering periodical after periodical contains criticisms and discussions, constructive and otherwise. In a word the shortcomings of engineering education are receiving in amount and kind, that publicity which should result in a vast amount of good.

The Carnegie Corporation has recently donated the sum of $108,000 to the Society for the Promotion of Engineering Education for the purpose of making possible a careful and critical study of engineering education. Mr. William E. Wickenden, Assistant Vice-President of the American Telephone and Telegraph Company has been appointed Director of Investigations. The Engineering Societies are appointing counsellors to advise and co-operate with the Board of Investigation and Coordination. The Joint Conference Committee of S. P. E. E. and the National Industrial Conference Board are expected to provide a means by which relations with the Industries can be maintained. The U. S. Bureau of Education is now compiling data on present engineering curricula. Such unified serious action with the conclusions which will be forthcoming will certainly be replete in benefits for engineering education in general.

HOMER H. HEUCHLING, '25

It is with genuine sorrow that we announce the death of Homer H. Heuchling, '25. Homer had been ill with typhoid for more than a month. Toward the end of this period blood transfusion became necessary and LeRoy Martens, '25 volunteered for the operation, but to no avail. Heuchling died on December 21, 1923, at 6:15 P. M.

Heuchling was a Junior in the Chemical Engineering course. He was captain of last year's tennis team and manager of the present team. His leadership in sport and his companionability made him well liked and sincerely admired by his fellow students. His loss will be regretted alike by faculty and students of the Armour Institute of Technology, who extend their deepest sympathy and condolences to his mother, Mrs. Margaret Heuchling.

CHARLES PROTEUS STEINMETZ

So much has been said in the contemporary press in reporting the details of the life and work of Charles Proteus Steinmetz, scientist, electrical wizard, and late Chief Consulting Engineer of the General Electrical Company, that little can be said here which will add to the general knowledge of our readers concerning this great man. However, to include no mention of the loss entailed by his brother engineers, our country, and civilization in general, in the passing of Dr. Steinmetz, would be decidedly malapropos and regrettable. We cannot do better than to quote from an editorial of *The Minnesota Techno-log:*

"There are few men who have ever contributed to their field such a wealth of material from both the theoretical and the practical side as has this peerless electrical genius. It has been said of him: 'He was allowed to try to generate electricity out of the square root of minus one.' This, to many students, is probably quite as conceivable as are some of the long and 'obvious' mathematical proofs which were so simple to him.

"Steinmetz was indeed like few other men, as Professor Karapetoff of Cornell, clearly shows. 'It was impossible,' he writes, 'to make him do anything except what he himself desired to do. He stayed away from the works for days; he smoked in buildings in which the president himself did not dare to smoke; he used the clockwise rotation of vectors when everybody was using the opposite rotation; he insisted on saying "ze" for "the"; he wore a soft shirt and a shabby gray suit at formal functions; and he belonged to a political party that cussed his company and its principal customers for years.'"

So much for present comment upon the death of the world's greatest electrical engineer. But as an added tribute to Dr. Steinmetz, and to demonstrate our deep appreciation of his great merit and our sorrow at his death, an article, dealing in detail with the life, inventions, patents, and work of Dr. Steinmetz, is being prepared by the three Senior students in the Electrical Engineering Department. This article and tribute will be published in an early issue of The Armour Engineer.

(Continued on page 77)

ABSTRACTS

M. H. Cooper, *Editor*

ZR-1 Model Studied in Massachusetts Institute of Technology Laboratory

The Bureau of Aeronautics of the Navy Department has just permitted public announcement that a study of a celluloid model of the airship ZR-1 by means of photoelastic methods has been carried on during the past ten months in the laboratories of the Massachusetts Institute of Technology. It is believed that these tests will be of distinct value in the design of airships to prevent a repetition of the ZR-2 and Roma disasters.

The model consists of several thousand pieces of celluloid machined precisely to scale and fitted together in a miniature duplicate of the airship. The testing was performed in the photoelastic laboratory of the Department of Physics by Dr. Paul Heymans and T. H. Frost, of the Technology Staff, under the general supervision of Prof. Charles L. Norton, Head of the Department of Physics.

The phenomena of photoelasticity have been known to science for some time, but have been employed only recently to settle troublesome problems of structural design, many of which cannot be mathematically determined. By this method polarized light is passed through the celluloid of the model under different loading conditions, and the stresses appear in rainbow colors. Since celluloid acts structurally as do metals used in construction, it is possible by varying the loads on the laboratory model, to determine just how the airship itself will act under various conditions.

As Professor Heymans states: "By this photoelastic method we can look into the vast and intricate network of the dirigible and see exactly what is going on when it is laboring. We can see how she is carrying and distributing the load. We have made an analysis of the ZR-1, showing exactly how the stresses are taken up by the members of the frame and the wires. When we hear of new forces which the ship must meet in its ventures overhead we can try them out on the model here at Technology."

The Technology Department of Physics is the only laboratory in this hemisphere equipped to carry on this work.

The Tech Engineering News.

New Motor Fuel in Great Britain

A new motor fuel called "benzolit" is being advertised in British oil trade journals, so Vice Consul De Vault at London has informed the Department of Commerce. The new fuel is made up of 50 per cent benzol, 20 per cent gas oil, and 20 per cent alcohol. It is said to be a successor to a preparation known as "tetralil" which is a mixture of benzol and tetralene or tetralin.

The latter is a water white liquid derived from naphthalene, is of about 0.975 specific gravity, boiling at about 400° F. congealing at 86° F., flashing at 172° F. and of a high B. T. U. value. In practice it is mixed with an equal quantity of gasoline or benzol and is said to give very satisfactory results.

National Petroleum News.

Ethyl Fuel

An announcement made by C. F. Kettering at the Midwest S. A. E. meeting recently is of interest to every automobile driver. This announcement has to do with the placing upon the market shortly after the first of the year, a new fuel for internal combustion engines. This fuel will be marketed by the Standard Oil Company of Indiana, at a slight premium over gasoline.

The big advantage possessed by this fuel over the present day fuel is that owing to the addition of tetra-ethyl lead to the gasoline which forms the base of the fuel, the so called "fuel", "spark" or "carbon", "knock" is eliminated entirely. In addition to tetra-ethyl lead, a chlorine compound is added, as otherwise the lead compound would be burned to litharge and deposited to some extent upon the valves and spark plug electrodes.

Different kinds of gasoline require different amounts of "anti-knock fluid," or "compressionizer," and apparatus for mixing and metering the fluid will be so arranged that the proper amount of fluid will be added to each gallon of gasoline.

The principal advantage of the use of fuel treated in this manner comes from the possibility of much higher compression pressures, and therefore greatly increased economy; although the performance of the common automobile engine of comparatively low compression pressure is materially bettered by the use of this fuel. Vibration is lessened and the car gives more power on hills and greater acceleration.

However, the General Motors Company, plans to make the additional and extremely desirable advantage of increased efficiency and economy, available to the public in the near future. As soon as Ethyl Fuel is generally available in a given city, special pistons, designed to give greater compression ratios, will be marketed.

With the disturbing probability of a petroleum shortage, and with it a shortage of the more volatile fractions suitable for internal combustion engine fuel, facing the rising generations, the above report provides considerable solace for those of us who concern ourselves with the great impending fuel problem. Ethyl Fuel is decidedly not a solution of the problem, but it will undoubtedly help greatly in carrying us over to the time when non-petroleum fuels will be available, or other complete solution of the problem will be made.

The discoveries which made Ethyl Fuel possible are the results of the work of Thomas Midgely, Jr., Vice-President of the General Motors Research Corporation.

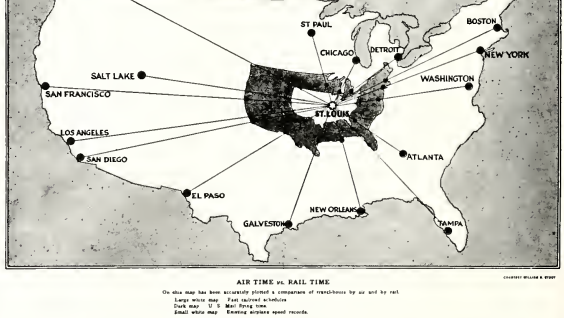
New Method of Estimating Crops May Be Adopted

The practicability of measuring crop acreages by means of aeroplane photographs is being determined by the United States Department of Agriculture in an effort to remove so far as possible the hazard of errors in crop reporting.

In recent experiments at Tallulah, La., in co-operation with the Army Air Service, photographs of fields of cotton, corn and hay were made at heights ranging from 2,500 to 7,000 feet with the plane traveling at the rate of 80 to 90 miles an hour. In photographs taken at 7,000 feet it is possible to distinguish the fields planted to various crops. With the use of a planimeter it is then possible to measure the exact acreage in the different fields shown in the photographs. The camera used is automatically operated and takes a picture 7x9 inches in size, each exposure at an elevation of 7,000 feet showing an area of approxi-

(Continued on page 70)

The Shrinking Map



AIR TIME vs. RAIL TIME

On this map has been accurately plotted a comparison of travel-hours by air and by rail.
Large white map: Fast railroad schedules
Dark map: U. S. Mail flying time
Small white map: Existing airplane speed records.

DILUTION OF THE CRANK CASE OIL OF AUTOMOTIVE ENGINES

(Continued from page 54)

the oil in one tube is known it is possible to evolve a scale mathematically by which the viscosity of the unknown

The Dilutometer in new oil indicating the oil is good.

The Dilutometer indicates this oil is used and is unsuitable for further use.

oil can be read direct. Inasmuch as the temperature of the oil in both tubes would be the same at the time of test that the grade of fuel he is using, accentuates dilution. Factors which enter into this dilution problem are so numerous that the present stated period of draining the crank case does not remedy the situation. In draining the oil at predetermined periods, it is discovered either that the oil is past the point of suitability or that it still contains sufficient body to properly lubricate and, therefore, should not be thrown away.

Much has been said about methods to overcome dilution. The problem is twofold—(1) affecting the ten million automotive engines already in operation, which cannot be re-designed, and (2) the future production of automobile, truck and tractor engines.

A preventative is not so essential for the present as some means for automatically extracting the dilution from the crank case oil during the operation of the engine. This may be accomplished by the use of an apparatus now being developed, which takes the oil from the crank case and draws it by gravity at certain intervals. There is no question, as actual demonstrations have proved, that with such an apparatus the body of the lubricating oil can be maintained and the grit and road dust eliminated.

The second or preventative type will have to be included in the design of the engine. It may be possible to arrange the pistons and cylinders so the fuel will be taken off at a point above the crank case so it will not dilute the motor oil. This will require some slight changes in construction and the introduction of a dome device for separating the fuel and lubricating oils that drain from the cylinders.

Increased temperatures and devices for re-running the fuel will also greatly assist in the prevention of dilution. Whatever is done with the fuel in getting better carburetion will tend to prevent the leakages of the unburned fuel which, as shown by the moving picture work done at the Bureau of Standards, simply drains into the crank case.

From the foregoing it will be seen that relief is being worked out for the motorist along various lines, the need for this relief becoming more acute from month to month. Yet the car, tractor, and truck owner or driver must realize that until such a time as these designs or apparatus are perfected and made part of the engine, the burden rests squarely upon his shoulder. If he fails to heed the warning to give proper attention to the condition of the oil in

Figure 2. With this simple little instrument viscosity can be determined in two or three minutes.

no temperature correction would be required. The accuracy of this instrument has been shown to run higher than 98½ per cent to 99 per cent in Saybolt seconds after the operator has become a little experienced, and at all times the error is negligible for practical work. The instrument is so constructed that to make a test it is only necessary to insert the nozzle in the used oil and fill like a syringe. The determination is made and the viscosity at 100° Fahrenheit read direct on the scale. To eject and clean the instrument it is only necessary to return the plunger handle to its original position, whereupon the oil is discharged and the tube thoroughly cleaned. The entire operation would not require thirty seconds for a medium oil. No stop watch, thermometer, cleaning apparatus, conversion tables, and so forth, are required and the difficult laboratory test of viscosity is reduced to a simple manipulation.

Such devices allow the motorist to determine when his motor oil is getting too light in body so that it is not giving the proper piston seal. They also tell him that his fuel mixture is incorrect, or he is using the choker too freely, or means of the intake manifold vacuum through a stove heated by the exhaust gases. From the stove the oil goes into a purifier, where the heavy ends are drawn off and put back into the intake manifold. By an automatic device the oil is returned to the crank case by the crank case, draining same when diluted beyond a reasonable factor of safety, he cannot expect continued free operation economy from the engine.

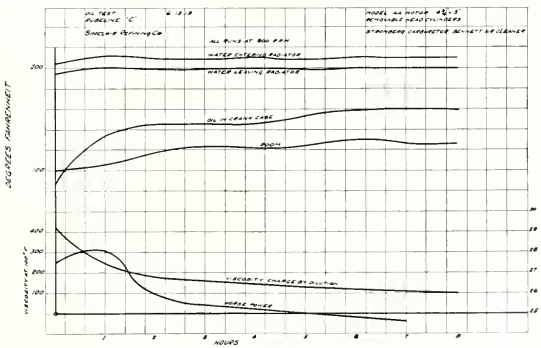


Chart II. Test of a tractor engine showing the effects of dilution of the lubricant.

COLLEGE NOTES

The 108th Ordnance Company

THE ARMOUR ENGINEER takes pleasure in presenting to its readers this first account of a new student activity.

The 108th Ordnance Company of the 33rd Division, Illinois National Guard, manned entirely by A. I. T., was organized on October 21. By October 29 the quota of 25 men had been filled. It was inspected by Colonel Lorne C. Greaves, and as a result of its good showing the strength was raised to 48 men.

The 33rd Division is the third division to be federalized, being preceded by those of New York and Pennsylvania. The 108th Ordnance Company is the first ordnance company to be created in Illinois. The Company is under the command of Lieutenant Colonel Walter Fisher, Provost Marshall of the 33rd Division. While the Company is now to be maintained at a strength of 48 men, if sufficient enlistments are made it is possible that an enlargement to a full rating of 165 men will be made. Any men interested in the training which enlistment in this Company will secure can obtain any desired information from Lieutenant M. C. Adams at 33rd Division Headquarters, or from H. J. Luth at A. I. T.

The student officers are 2nd Lieut. Walter R. Treff, who received his commission November 27. The sergeants are M. Veggeberg, O. Hardstedt, B. Coffey, J. Morrison, R. Montgomery, H. Hammer. The corporals are H. J. Luth, R. Walworth.

The Company is being equipped at present. Uniforms have been received and will shortly be followed by small arms and automotive equipment, which will include seven trucks, of which two are heavy duty, and one will be fitted with a complete automotive repair kit.

The essential work of an ordnance company is the maintenance and upkeep of mounted guns. The 108th Ordnance Company will have charge of moderately heavy artillery, including 75 mm. caliber. A technical sergeant from the Rockford Arsenal will be assigned to the Company to instruct the men in the various mechanisms. The plans of the Company are not limited to the technical side alone but will also provide recreation for its members. Wrestling instructors will be secured and boxing will be taught. It is planned to organize a basketball team and a polo squad.

Another interesting phase of the Company's activities lies in the semi-monthly hikes which are to be taken during the spring, summer and fall. The motorization will permit of considerable distances being covered, and the territory within a radius of 75 miles of Chicago will comprise the sphere of action. These trips will be made over week-ends. They will also foster inception of many friendships born beside the campfire, and strengthened by toil and pleasure experienced together.

The non-commissioned officers of the 108th Ordnance Company. Note the stern composure indicative of grave responsibility.

Dean M. E. Cooley was the guest of honor at a dinner given by the Detroit Engineering Society, the Detroit sections of the American Society of Civil Engineers, American Institute of Electrical Engineers and the American Society of Mechanical Engineers, at Detroit, on November 23. The debt of the engineering profession to Dean Cooley, not only for his services as an engineer, but for his accomplishments as a man, was acknowledged at this function. It will be recalled that Dean Cooley's discussion "The Responsibility of Education" appeared in the November issue of THE ARMOUR ENGINEER.

Greater Station 9YL

A gift of a complete radio broadcasting set has been received by Armour Institute of Technology from the Wieboldt Stores of Chicago. The set was formerly operated by them under the call letters W. P. A. D.

The following extract from a letter from Mr. Elmer F. Wieboldt of Wieboldt & Co. explains itself:

"We propose to give outright all equipment and parts now incorporated in our Radiophone station as a complete unit. It is understood that the Institute is to use it in connection with the giving of instruction and for purposes of research work."

The set uses 4-250 Watt tubes with 50 Watt and 5 Watt tubes for amplifiers and for modulators. A 5 H. P. motor generator set and two motor generators of 1 H. P. each are included. The power for the large tubes is D. C. at 2000 volts. The 50 Watt tubes use 1000 volts D. C. The filaments of the large tubes use A. C. storage batteries, microphones, switches, ammeters, voltmeters, condensers, and all other necessary electrical equipment for a complete radio station are included in the gift.

The apparatus is now in Chapin Hall. As soon as power connections can be installed the set will be put in operation by members of the Radio Club. The work of connecting up and operating the set will be done by them, and much valuable experience will thereby be gained. It is the intention to operate for the present on the Technical and Training license of the Armour Tech station 9YL using the aerial recently constructed back of Chapin Hall. The license permits the use of Radiophone on 175 to 200 meters and C. W. transmission from 150 to 220 meters. Parts of the set have already been used in connection with the course in Radio Communication.

Faculty Club

One of Armour Tech's organizations which functions unknown and unseen by the student body is the Faculty Club. The Faculty Club is the inner retreat of all the Profs who weary at any time of the freshman's ingenuous excuses, the sophomore's ingenious excuses, the junior's importunate question, or the senior's blatant knowledge.

The Faculty Club offers relaxation and recreation to its members and serves as a medium by which they may keep in touch with other fields of engineering effort than their own. We suspect that it has been the scene of many a wordy battle, not the least important being that between Mr. Kennedy and Professor Schommer as to the relative merits of fly-fishing and bait-casting.

The officers of the Club who serve for one year are:

President, J. E. SNOW
First Vice-President, C. A. NASH
Second Vice-President, J. J. SCHOMMER
Treasurer, C. R. SWINEFORD
Secretary, R. J. FOSTER

One of the chief social affairs of the Club is the annual smoker. The latest

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SOCIETIES

THE ARMOUR ARCHITECTURAL SOCIETY

All of the ancient mysteries sacred to the domain of architecture and architectural students were revealed to the Freshmen of that department at the time of their initiation into the society on December the eighteenth. The particular accomplishments of the upper class men were demonstrated to the fullest comprehension of those just taking the vows, in the subterranean caverns of the Club Room of the Art Institute. Then, to the accompaniment of a menu that some have not yet deciphered, there followed the banquet in the Refectory. The Society had the particular pleasure of Dean Monin's presence at the banquet, as well as that of Messers Campbell, Zettler and McCaughey of the department, and Hofmeester and Bieg from the alumni.

Following Massier Stiehl's introduction of the Senior Class, Dean Monin spoke on architecture in its more modern phases and also emphasized the relations of the department to the Institute as a whole. Mr. Campbell went on to explain the connections with the Beaux Arts Institute of New York, and also to define the relative position of the Armour Architectural Department with that of other schools. Following the banquet, a twenty-minute sketch competition was held, having as its subject, "The Decorations of a Locomotive." The jury—one of the most enthusiastic ever assembled—after long and careful, if somewhat hilarious deliberation, awarded "The First Medal" to Bloom. We have not yet discovered why he is not wearing it.

Plans for a smoker and the presentation of an architectural burlesque are being made for the end of January.

The work in Senior design has centered around the Beaux Arts program for "The Decorations of a Cabaret" as its principal pre-Christmas activity. A number of finely executed drawings were made, and Mr. Campbell will be in New York to witness the judgment in January. The present program calls for the presentation of a shopping center in the form of an arcade building.

Juniors completed at the time of the Christmas Holidays, their work on "An Administration Building for a Park," and the Sophomores their sketch problem, "A Golf Club." The Freshmen have been executing some very fine drawings in the form of archeological ink renderings.

WESTERN SOCIETY OF ENGINEERS

The Armour Branch of the Western Society of Engineers has had several very good meetings since the last issue of THE ARMOUR ENGINEER.

On Monday, November 1, Mr. L. T. Smith, a senior civil student, gave an illustrated talk on tunneling. He spoke for the most part about the Vehicular Tunnel in New York, on which he was employed this summer.

At the second meeting Mr. T. L. Condron, President of the Condron Company, gave an illustrated talk on "Some Unusual Engineering Problems of Interest to the Engineer in General."

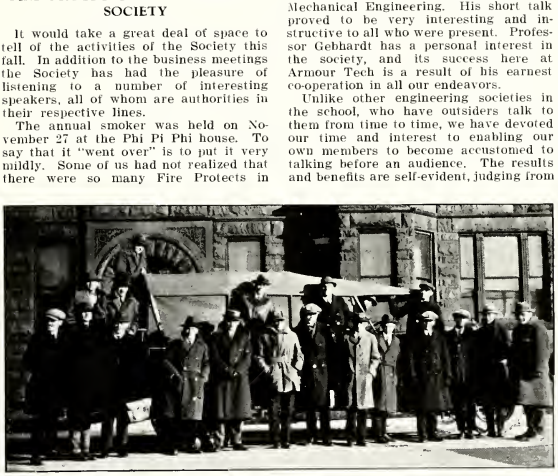
The third meeting of the year was attended by about one hundred students and several faculty members. The speaker was Col. H. C. Boyden of The Portland Cement Association. His subject was "Concrete," and proved to be very interesting.

All members of the Civil Engineering Department who are not affiliated with the W. S. E. are urged to join. Students of all departments are cordially invited to attend the meetings. The meetings are held the first and third Thursdays of the month at eleven-thirty.

FIRE PROTECTION ENGINEERING SOCIETY

It would take a great deal of space to tell of the activities of the Society this fall. In addition to the business meetings the Society has had the pleasure of listening to a number of interesting speakers, all of whom are authorities in their respective lines.

The annual smoker was held on November 27 at the Phi Pi Phi house. To say that it "went over" is to put it very mildly. Some of us had not realized that there were so many Fire Protects in



Senior Fire Protects enroute to the Fire Department Drill School. Someone had to stand in front of the "C. F. D." on the red truck and spoil the whole picture.

school. They were all there and they all had a good time. Mr. Townley, veteran fire insurance man, told us some very interesting things about his experiences in the Fire Insurance business, after which Professor Amsbary gave us some of his incomparable sketches. Then came a melodramatic movie entitled "The Menace." The evening was closed with refreshments and a little vocal music by an extemporized glee club.

Among the speakers this fall were Mr. Goldsmith, who talked on the National Board Town Rating Schedule, Mr. Bergster who spoke on Exterior Fire Protection, and Mr. Cole who told us about The Broker and His Relations to the Companies. Last but not least was Chief Matt Murphy of the Chicago Fire Department and its training school. During the course of his talk he unguardedly extended an invitation to visit the school, and spoke of sending a squad wagon as conveyance for the crowd. This was too much for the Seniors and they accepted his invitation the following week.

Mr. Townley is at present working on a design for the "shingle" for members of the Society. This is expected to be on exhibition in the near future.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The student branch of the American Society of Mechanical Engineers held their first meeting, October 4, 1923. President Ruddiman opened the meeting, by introducing to the society Professor Gebhardt, head of the Department of Mechanical Engineering. His short talk proved to be very interesting and instructive to all who were present. Professor Gebhardt has a personal interest in the society, and its success here at Armour Tech is a result of his earnest co-operation in all our endeavors.

Unlike other engineering societies in the school, who have outsiders talk to them from time to time, we have devoted our time and interest to enabling our own members to become accustomed to talking before an audience. The results and benefits are self-evident, judging from the interesting talks which have been given by our members.

Our interest at the present time centers around our annual smoker which is to be held soon. We hope to make it the best we have ever had with plenty of good things to eat and good smokes.

The following officers have been chosen to bear the responsibilities of the organization for the year of 1923-24.

President, G. R. RUDDIMAN
Vice-President, D. L. HELLER
Secretary, E. A. BARRETT
Treasurer, C. A. RIFE

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The Armour Tech branch of this society has been very fortunate in obtaining speakers who presented forcibly the pos-

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ATHLETICS

CROSS COUNTRY TRACK

The cross country track season closed this year with a very good record considering the fact that it is the first year that A. I. T. has had a team in intercollegiate competition in this field. The last two meets were with Y. M. C. A. College, and at the Kosciusko Seven Mile Road Race.

The Y. M. C. A. College meet was held on November 7, on the Washington Park course of three miles.

Results of Cross Country Meet Held November 7, 1923

ARMOUR TECH won over the Chicago Y. M. C. A. College.

Score:

ARMOUR	14
CHICAGO "Y"	22

TIME: 16 Minutes, 53 seconds.

Following are positions of Armour Runners during the Race:

AT END OF FIRST MILE:

TIME: 5 Minutes, 35 seconds.

1. YMCA
2. YMCA
3. YMCA
4. Robinson, Armour
5. Payne, Armour
6. YMCA
7. Berry, Armour
8. McHenry, Armour
9. Ball, Armour
10. Owens, Armour
11. Heller, Armour
12. Scholz, Armour

AT END OF SECOND MILE:

TIME: 11 Minutes, 24 seconds (2 miles)

1. Robinson, Armour
2. YMCA
3. Payne, Armour
4. Berry, Armour
5. YMCA
6. Ball, Armour
7. YMCA
9. McHenry, Armour
10. YMCA
11. Scholz, Armour
12. Owens, Armour

AT FINISH: TIME: 16 Minutes, 53 seconds (3 miles)

1. YMCA
2. Payne, Armour
3. Robinson, Armour
4. Berry, Armour
5. Ball, Armour
6. YMCA
7. McHenry, Armour
8. YMCA
9. YMCA
10. Owens, Armour
11. Scholz, Armour

It was originally planned to count the first five men of each side. "Y" College could not produce 5 men. 4 "Y" men ran, hence first four men counted for each team; that is the first four men of either team over the finish scored for their respective side.

On November 3rd, Coach Phalen entered six men in the Kosciusko Park Seven Mile Road Race. The competition in this meet was severe, and the leaders were well bunched when they crossed the tape.

Results of 7 Mile Road Race

Kosciusko Park, Saturday, November 3rd, 1923.

The following runners for Armour are listed as their respective places in the meet:

At the end of the first mile:

14. Berry	20. Payne
18. McHenry	22. Ball
19. Robinson	23. Scholz

At end of the sixth mile:

13. Berry	19. Robinson
17. Payne	20. Scholz
18. Ball	21. McHenry

At the finish:

13. Berry	19. Robinson
14. Payne	20. McHenry
18. Ball	21. Scholz

It is noteworthy that Berry of A. I. T. crossed the tape just 1 minute 7 2/5 seconds behind Chuck Mellor of the I. A. C., winner of the race.

A large number of other men are eligible now and a new flock of Gold A's will probably soon be about the Institute.

BASKET BALL

Tentative Basketball Schedule

December 15, Armour at Notre Dame.
December 18, Millikan at Armour.
January 8, Loyola at Armour.
January 11, Augustana at Armour.
January 17, Western State Normal at Armour.
February 2, Armour at Augustana.
February 5, Armour at Loyola.
February 9, Detroit at Armour.
February 15, Notre Dame at Armour.
February 20, Lake Forest at Armour.
February 22, Armour at Detroit.
February 23, Armour at Western State Normal.
March 1, Armour at Lake Forest.
March 8, Armour at Millikan.

A flock of A's. Isn't the gentleman on the left preparing to "wind up"?

HONOR "A" SOCIETY

The first meeting of the Honor "A" Society resulted in the election of the following officers:

W. F. Desmond, *President*
O. M. Spaid, *Vice President*
L. E. Burke, *Treasurer*
A. J. Danziger, *Secretary*

The winning of a major letter in any sport makes a man eligible to the society. The membership at present includes the following:

C. J. Plocar.	BB,T
O. M. Spaid.	B,T
E. E. McLaren.	B.
C. E. Andrzelczyk.	BB.
W. F. Desmond.	BB.
L. E. Burke.	BB.
A. J. Danziger.	B.
A. H. Joseph.	BB.
E. R. Geiger.	BB.
H. J. VanDyke.	BB.
R. P. Gaylord.	B.
C. D. Johnson.	T.
D. L. Heller.	T.
Stan. Owens.	T.

B—Letter in Basket Ball
T—Letter in Track
BB—Letter in Base Ball

The games with Northwestern University and University of Chicago were cancelled because of conference rules prohibiting games with colleges who allow their freshmen to play.

Armour Tech started the season with a game with Notre Dame, at South Bend, and in spite of the fact that the team was in poor condition, it played a good game. Notre Dame won, 29 to 17.

The first home game was played with Millikan University. During the first half, Armour Tech had the north basket, and by fast playing in which the basket shooting of Joe McLaren was a feature, ended the first half 22 to 20 in our favor. The Millikan team were dead shots at long range and came back in the second half with a bombardment which finally turned the score to 40-24 in Millikan's favor.

This year, all of the home games will be played in the Armour gym.

BOXING AND WRESTLING

The work of developing a wrestling team this year was started considerably earlier than last year with the result that

(Continued on page 77)

FRATERNITIES

SOMETHING ABOUT TAU BETA PI

Tau Beta Pi, founded in 1885, is the National Honorary Engineering Fraternity. It has at present forty-three chapters in the leading engineering colleges in the country. The last two of these chapters: Beta of Washington, State College of Washington, and Gamma of Massachusetts, Harvard University, were installed during the year 1923. The chapter at Armour Institute of Technology is known as Beta of Illinois. This chapter was founded in April, 1906, and is number fourteen on the chapter roll.

The official insignia of this brotherhood is the Tau Beta Pi key, or "Bent."

Elections to membership to Tau Beta Pi are held bi-annually—in the spring and in the fall. At the spring elections those Juniors who come within the highest one-eighth of the class, scholastically, are eligible to be voted upon for membership. At the fall elections those men in the highest one-quarter of the Senior class, together with the Junior with the highest average in his class, are eligible to election.

Lists of candidates who are eligible scholastically are obtained from the Dean's office. Every eligible candidate is considered in these elections, in the order of his scholastic standing. Elections are by a majority vote.

A close restriction is placed upon the number of members a chapter may have at any one time.

Beta Chapter of Illinois announces the installation of Joseph Bernard Finnegan, Professor of Fire Protection Engineering, as an Honorary Member.

Announcement is also made of the initiation on January 10 of the following students:

SENIORS

E. A. Barrett
F. H. Blumenthal
J. R. Brady
M. H. Cooper
J. C. Friedman
E. N. Harsha
E. A. Klein
E. E. McLaren
F. R. Nelle
E. L. Niederhofer
D. E. Richardson
G. P. Ruddiman
C. A. Stiehl

HONOR JUNIOR

M. F. Adair

SPHINX

Sphinx—the new, the active, the enlarged, is completing a busy semester and entering upon a busier one. At the outset the old Sphinx Pin was replaced by the more appropriate key. Look for it around the campus. It is a badge of hyper-distinction. If you want to know anything about our college, past, present, or future, its faculty, its alumni, its students—ask the wearer of the key. He knows! But if he won't tell you, just remember he is a Sphinx.

Each member of Sphinx holds or has held an important position on the Staff of *The Cycle* or *The Armour Engineer*.

Those men upon whom our key has been conferred during the past semester are:

A. A. Anderson
R. M. Beckwith
F. H. Blumenthal
W. E. Schweitzer
O. M. Spaid
L. E. Thoelecke
H. P. Whitehill

At a recent meeting Sphinx voted the honorary presentation of its badge of membership and distinction upon

Professor C. E. Paul
Professor J. C. Peebles
Professor W. A. Hendricks

Outside of the conduct of a large amount of detailed business in the field of the publications Sphinx plans a number of non-business meetings with the staff members of publications other than our own. By this, and other means, Sphinx will broaden to its greatest possible scope.

SCARAB

Europe, and the chance for travel and study abroad, is probably the goal of every student of architecture. Although none of the active Scarab men have yet taken out their passports, they are at least getting into preliminary training for foreign travel by ventures into notorious Hyde Park and distant Englewood.

A visit to Lorado Taft's studio, which was probably the outstanding event of recent weeks, not only gave a more adequate knowledge of Mr. Taft's work, but revealed the means and methods employed in sculptural art that were hitherto unknown to the "uninitiated." An uniquely illustrated lecture by A. Erwin Nicolai on his European trip, including a little of Italy and of everything else, with special references to St. Peter's Dome, was the occasion of the Hyde Park debut; and an acquaintance with some very beautiful and historical marble specimens at N. Leslie Flint's was the reward of the Englewood pilgrimage.

Edfou Temple is particularly concerned at this time with the production of the Scarab publication, and the gathering of sketches for the traveling exhibition of water color and pen-and-ink work.

SALAMANDER

At meetings held during October the following were pledged to Salamander:

M. H. Cooper
R. B. Grove
E. J. Miessler
E. F. Sisson

We are pleased to announce that Salamander is to possess a beautiful new door plate patterned after the key. According to desires of the alumnae, we are publishing a news letter for their benefit. For the carving of this pattern we are indebted to Mr. S. L. Chaney, Industrial Arts Student.

At present Salamander is planning to hold regular "get-to-gethers" for the purpose of exchanging information. We hope to make these meetings of very real value.

Informally, the Junior Fire Protects are being carefully looked over. Until next semester, however, speculation is idle.

CHI EPSILON

On the evening of November 22, at a banquet held at the Chicago Engineers' Club, the following men were initiated into the Armour Institute of Technology chapter of Chi Epsilon:—

H. C. Friedman, '24
L. Pfohl, '24
E. L. Niederhofer, '24
A. J. Zelenka, '24
L. M. Holmes, '22

Mr. Holmes will be remembered as one of the prominent members of the Class of 1922. He is at present employed with the Ekco Engineering Company.

Interesting talks on various topics were given by our honorary members, Mr. E. G. Nethercut and Professor A. E. Phillips. The following alumni were in attendance: Morrison, '22, Hess, '23, Goedhart, '23, and Myers, '23.

Our activities for the balance of the semester will consist of literary meetings and the election of officers for the last half of the year. We are watching the Junior Civils very carefully at present, since our membership for next year will be taken from among them.

ETA KAPPA NU

Beside our usual meetings, formal and informal, Delta chapter of Eta Kappa Nu had the pleasure of a joint meeting with the Chicago Alumni Chapter, on November 13. The dinner held in connection with this meeting was an excellent example of their management ability. The speakers of the evening "did themselves proud" and had much of interest for us all. A few Delta men took their turn at supplying a portion of the entertainment. They also gave reports on topics of individual research which have interested them during a portion of the first semester.

This reminds us that another lap of the course is almost complete. It should always be the aim of the engineer to raise his mark higher, wherever he may be, and we will soon have a measure of how well the "A" men are accomplishing this end.

The officers of Delta chapter for the current college year are:

President. D. E. Richardson
Vice-President. T. E. McDowell
Corresponding Secretary. E. L. Carlson
Recording Secretary. R. L. Coultrip
Treasurer. J. A. Aalberg
Associate Editor of "The Bridge," L. L. Swartz.

TRIANGLE

Since The Armour Engineer readers last heard from us we have moved to our permanent home; that is, permanent as long as A. I. T. remains at "Toity-toid an' de tracks." It is almost needless to mention that everybody is very much in love with the new house.

On the night of the Frosh Frolic, after the sketches, the boys stepped over to the house, pushed back the rugs, and danced away the rest of the evening with their fair partners.

Our main social event of the first semester was the New Year's Eve Party, which was graced by many alumni.

Triangle announces two more pledges since the last issue went to press: HEYES and STREETER.

PHI KAPPA SIGMA

The combination of Holidays and the approaching "finals" has served to keep the men of Alpha Epsilon from oblivion regarding the world in general and the "college" in particular. Studies have been much in order, and the supply of midnight oil runs low.

Alpha Epsilon has entertained with a hard times party on November 24, and has celebrated its 25th anniversary as a chapter in Phi Kappa Sigma Fraternity with a banquet at the chapter house. Some of the older alumni present on this occasion were:

R. T. FRY, '01
A. M. JENS, '04
W. F. HARVEY, '05
N. W. COOK, '06
J. T. WALBRIDGE, '07
J. HARVEY, '09
A. M. NEIMZ, '12
R. J. GEISLER, '12
O. E. KLING, '14
B. D. SCHNABLE, '14

Preparations are under way for our Tri-Chapter Formal which will be held in the very near future.

Alpha Epsilon of Phi Kappa Sigma extends her best wishes to the various organizations at Armour Tech, and looks forward to a prosperous year for all.

SIGMA KAPPA DELTA

Looking back over the season's activities, Sigma Kaps find an especially bright spot on November 2, when the annual Hallowe'en dance was held. Not in years, has such a combination of soul teasing music; weird and cabalistic decorations and mystic spirits been combined to make up a perfect evening.

Looking ahead at this time, we anticipate an equally enjoyable evening that will send us home for the Holidays with happy remembrances. This event is planned for the night of December 21.

Incident with perfecting the organization of our Alumni Association, we have had two smokers; the first on November 10 and the second on December 6. Officers were chosen for the coming year and future activities discussed.

Although we won our first game in the inter-fraternity basket-ball league, we were unsuccessful in the game with Phi Pi Phi, who galloped off with the championship for the third consecutive year. We wish to extend our congratulations to the Phi Pi Phi Fraternity on their accomplishment and hope that in the future all inter-fraternity events will be as successful in promoting good feeling between the houses as have the events just run off.

PHI PI PHI

On November 16 the Beta Phi Fraternity changed its name to Phi Beta Tau. The following men were initiated in Phi Beta Tau on November 21, 1923.

W. DOWNES
L. LOWDEN
W. DIXON
P. CONNELLY

On November 24, 1923, Phi Beta Tau, local fraternity, was installed as Gamma Chapter of Phi Pi Phi, national fraternity. Phi Pi Phi inaugurated itself socially at Armour Tech with a banquet immediately following the installation ceremonies.

The following men have been pledged to Phi Pi Phi:

W. MILLER
G. MORGAN
G. VER PLANK
W. SCHOLZ
M. KLEIST
W. PACKARD
W. KUFFEL
L. BURK
T. O'MALLEY
W. JOHNSON

Phi Pi Phi in a close game with Delta Tau Delta won the coveted inter-fraternity basket-ball cup for the third consecutive year, thereby earning the right to keep the cup permanently.

The annual smoker of the Fire Protection Engineering Society was held at the house on November 27. Smokes and entertainment served to keep the fire eaters cool and happy.

The members of Gamma Chapter turned out in force to a tri-chapter dance at the Orrington Hotel, in Evanston, December 15.

DELTA TAU DELTA

The activities of the chapter at the present writing are being mainly directed toward scholarship. The holidays are close upon us and every effort is being made to make a fine finish of the semester's work.

Social activities are not being neglected, however, and the annual Faculty Smoker was held November 23 and was voted one of the most successful events of its kind in the history of the chapter.

The annual Pledge's Dance was given at the chapter house on December 14 and was much enjoyed by the actives and pledges as well as by a number of alumni and visiting brothers from our neighboring chapters at Northwestern and Chicago.

The biggest social event of the year, the "Delt Prom" will be held at the Blackstone, February 15, and the entire chapter is looking forward to a wonderful time.

Brother D. E. Rutishauser, '23, dropped in on us recently and the chapter was glad to hear that he will be in Chicago for the months of December and January. His headquarters are in Rochester, New York.

The engagement of Brother M. C. Nutt, '23, of Moline, Illinois, to Miss Phyllis Small of Wilmette has just been announced. Miss Small is a student at the University of Chicago.

We regret very much the loss of Brother Abplanalp who found it necessary to leave school the first of December. He has always been one of our most active men, both at the Institute and in the chapter, and his loss will be keenly felt.

THETA XI

Our hope of having at least one hundred men of T. X. present on December 8 was surely realized. In fact one hundred and twelve men signed the register that day. The party was a stag and lasted from noon till midnight.

Among our own Alpha Gamma men, "Buck" King came from Louisville, Ky., Horace L. Butler from Springfield, G. L. Rykert from Sycamore, Chester Wolfley from Rockford, E. W. McMullen from Kenosha, Wis., Roy Hupp from Milwaukee, Wis., and J. L. Snyder from Lincoln, Neb. Brother "Rudy" Triest took occasion to run down from Madison, and helped the party greatly thereby.

A buffet dinner was served at seven o'clock, after which speeches were in order under the direction of the toastmaster, Brother F. W. Puckey. It was an inspiring assembly, with eighteen of the twenty-seven chapters represented.

Our chapter has been very fortunate in having many generous friends. Brother Addison A. Richter has presented us with a number of reproductions done in oil, and several genuine English etchings.

The honorary societies have been pledging around school, and Theta Xi is now represented by:

Brothers R. M. Beckwith and E. A. Klein in Tau Beta Pi.

Brothers E. A. Klein, J. S. Farrell, and W. J. Patterson in Eta Kappa Nu.

Brothers W. J. McCauley and L. C. Senescall in Scarab.

Brothers L. C. Thoelecke and R. M. Beckwith in Sphinx.

Brothers D. L. Heller, O. P. Robinson, and C. D. Johnson in Honor "A" Society.

We take pleasure in announcing the following initiations:

R. H. RUSK, Milwaukee, Wis.
O. P. ROBINSON (Active), South Chicago, Ill.
R. M. BECKWITH (Active), Joliet, Ill.
J. L. SNYDER, Lincoln, Neb.
H. L. BUTLER, Springfield, Ill.
H. A. STRAIN, Chicago, Ill.
C. E. WOLFLEY, Rockford, Ill.
O. R. HUPP, Milwaukee, Wis.
R. D. BECK, Chicago, Ill.

Although our present telephone number is not in the directory, we have been permanently assigned, Douglas 4488.

THE START OF ANOTHER DAY

(Continued from page 59)

Later, when the 8:30 crowd has thinned out a bit, a few umbrellas are seen on the street. Some of the professors are arriving from Rogers Park, Evanston, and points north. Two gentlemen are seen coming from Wentworth Ave., umbrellas held low as they buck the wind under the Rock Island tracks. One is Professor Perry, with Spangler's "Valve Gears" and the Saturday Evening Post under his arm. His companion is Professor Snow, carefully avoiding the puddles of water on the sidewalks, because he left his rubbers at the Institute the night before. In his hand Professor Snow carries two books; one is a treatise on color photography and the other looks like the autobiography of King Tut.

An Oakland sedan rounds the corner into Federal Street and stops in the parking space just south of the main building. The driver locks the ignition and alights briskly from the car. A solid, well-set figure, ruddy complexion, iron-grey hair, a ready smile; Mr. Allison, comptroller of the Institute. In the meantime his companion has stepped out on the other side of the car and turns back towards the sidewalk. He says "Good morning, boys," to a group of passing students, every one of whom he knows by name. Later, in his office, the senior professor of the faculty or the humblest freshman, should they choose to call, will be received with the same unfailing courtesy. Executive and scholar, President Raymond.

They pass in at the main entrance together. The day has officially begun.

THE SLIPSTICK

CLAUDE ALBON STIEHL, *Editor*

THE EXTENSION COURSE
in the
COLLEGE OF ENGINEERING
for the
YOUNGER GENERATION

LESSON NUMBER TWO
"HOLIDAYS AND HOMEWORK"

1. *Defin.*—"Holiday"—A day provided at frequent intervals in other colleges and almost never at Armour when the toiling student makes up overdue homework.

2. *Exceptions.*—The above rule is—as are all rules of respectable standing—open to certain exceptions. A few of these are, for example:

(1) If a holiday falls near Christmas, it is a legal acknowledgment of the fact that all students of Engineering will attend classes in the basement of the Post Office or at certain State Street Shoe stores.

(2) If there are a series of consecutive holidays the above rule (Paragraph 1) applies only to the last day of the series.

Examples of First Class Holidays:

Fourth of July, Christmas, Thanksgiving, Lincoln's, Washington's, and Campbell's Birthdays.

Second Class Holidays: (Not included in the Bulletin, but proclaimed by Unwritten Law.)

Registration Day, the day before and the day after every authorized holiday, Junior Week.

3. *Fractional Holidays.*—There is also a special class of holidays not included in the almanacs, and differing from the customary holidays in that they do not consist of the usual twenty-four and one-half hours, but fractions thereof, of one or more hours duration. Examples:

Class meetings, all regular assemblies, inspection trips, and Business Law.

4. *More Definitions.*—"Homework"—Classwork assigned to be done somewhere else, by someone else, for someone else.

5. *How Announced.*—Homework is usually pronounced as a benediction by the professor at the close of the class, beginning with the peculiar Greek word, "Takeforthenexlesson."

6. *History.*—As far as historical records go, homework seems to have originated in that quaint and distant time when astrology was the reigning science and the chief study of every medieval scholar. Obviously, laboratory experiments could only be conducted at night, and it was the custom of these ancient professors to assign problems in this science, the results of the investigations to be reported upon on the succeeding day. A liberal assignment, could, of course, be made in very few words, and this would allow the professors to impose the greatest amount of work upon their students with the least amount of effort on their own part.

Gradually, however, as astrology lost its high position in the university curriculum, and such practical sciences as calculus and sanitary engineering came into vogue, the excuse for night time investigations was at an end; yet the very agreeable custom formed by their professorial forefathers was one that the latter day professors were loath to give up, on the grounds that, frankly speaking, they did not know enough to keep their students entertained all day, and the easiest way would undoubtedly be to assign a lesson, send them home with it, and then go over to the Faculty Club for a smoke.

The poor student (see the "Nightingale and the Rose") seems to have fallen for this scheme, and we read of a time when college students actually burned the midnight oil in an honest effort to perform this diabolical homework. But with the advance of the New Age, Free Women, Picasso and Hiram Johnson, The Student has gradually come to see the light, and has invented a series of peculiar and interesting devices to combat this impending affliction. The game as now played has many interesting little points of *finesse*, one of the most important being that homework should never be done at home, but on the elevated, or during an English lecture or, if possible, in the class at the time it is due. Organizations, in the form of fraternities, societies, and clubs, assist in a Communistic division of labor, and frequently reduce the per capita effort to almost nil.

7. *Precautionary Measures.*—To assist the novice in this polite game of intellectual education, we give the following precautionary measures:

(1) When unable to complete homework on time, do not tell the professor so—by no means fall into this grave error! Instead, after looking hastily thru all papers, books, and brief cases, pronounce, in a manner of undoubted consternation, "I *must* have left it at home!" (This is the most important formula—memorize.)

(2) The second formula should also be memorized:

"One problem correctly copied from your neighbor is worth two worked incorrectly by yourself."

(3) The third formula and its corollary should also be noted:

"When turning in a copied paper, do not place it next to the original."

Corollary: Professors might be defined as a class of people who do not believe in coincidences.

MORE EVOLUTION

"When you were a tadpole and I was a fish"
In the pre-cafeterian age,
And we didn't know of the rate of flow,
Or hear of a pressure gauge,
I wonder if you, even then, didn't think
That you'd turn out an engineer;
For, "side by side, on the ebbing tide",
I remember your antics were queer.

In awe I gazed at the rising moon—
At its gorgeous immensity—
But you'd squirm aroun' 'til the thing went down,
Trying to figure its density!
And the waves on the beach and the star-fish forms
Were sights to delight my eye,
But you fretted and fumed when a wave entombed
Your sand-inscribed value of "pi"!

There we wiggled and woggled with never a thunk,
In those ante-world-leaguean seas,
With never a care for liquefied air,
Or Mohler's hypotheses;
And yet there was something about you, I know,
Some rather unusual bents,
For you didn't play in the usual way,
But worked at "experiments".

You counted the drops of spray in a wave,
And figured their impact on land,
And grain by grain on that broad beach plain,
You counted each bit of sand.
You labeled each pebble and weed on the shore,
You classified waves by their roar—
But your pace never faltered as continents altered,
And seas were not seas any more.

So down thru the ages we've lived and we've died,
Tho the world rolls around much the same,
And our point of view is the same we knew
When ours was another name.
They call me an artist, and you—engineer,
And give us new toys for old,
And we've traded our seas for the land's warm breeze,
And our sand pebble grains for gold.

Rivers you span with bridges of steel,
And mountains you pierce with mines—
And I watch with a smile as you scratch and file
At the earth's ineffaceable lines.
For the moon has the age old awe for me,
More so than a kilowatt glare,
And I spend my days in the futile ways
That some claim "won't get anywhere".

But under the surface of things as they are,
And under my dreams and your strife,
The two of us make the selfsame fuss
Of the Thing that we all call "Life".
And hidden away in our thoughts I know,
There's lurking a secret wish
That we might renew the time when you
Were a tadpole and I was a fish.

We submit for the benefit of the Glee Club, and other anti-musical organizations, including fraternity quartettes, and so forth, the following:

SCHOOL SONG

It is not up for any prizes, and is generally understood to be sung to the national college air

"BOHUNKUS"

and, as the hymnals would put it, in L.M. (Long Metre—the longer the better)

Where Thirty-third meets Federal Street,
And Federal, Thirty-third,
There Thirty-third meets Federal Street,
And Federal, Thirty-third.

(It must be admitted that the logic is unquestionable.)

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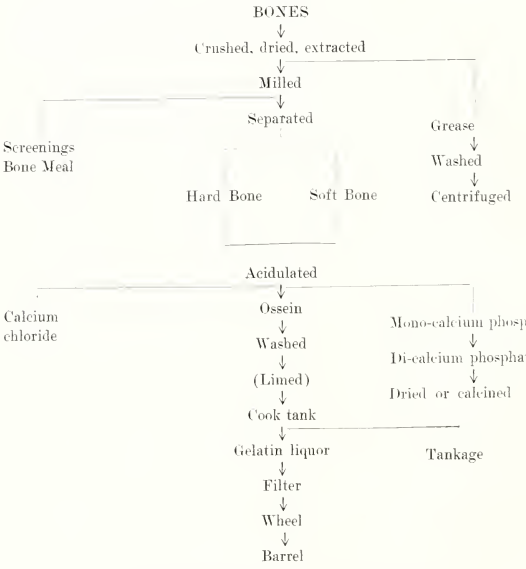
THE TECHNOLOGY OF GELATIN

(Continued from page 51)

precipitated di-calcium phosphate is recovered by filter pressing and drying or calcining as the demand requires. Since the production of ossein is an expensive operation, it is essential to recover all by-products to the best possible advantage.

The process to which any raw material is subjected depends upon the manner in which the gelatin is to be used. That is, gelatin to be used for photographic emulsions must be free from certain minerals, most important of which is chlorides, whereas a gelatin for ice cream manufacture should not have too low a pH.

Ossein Flow Sheet



PLANNING AND PRODUCTION CONTROL

(Continued from page 48)

manufacture of each article. These sheets should also show what machine is used, together with all the special tools, jigs, fixtures, dies, gauges, and templates. These instructions are used by the workmen as a guide for the work to be done.

Having determined upon the most efficient methods of doing the work it is next necessary to determine the time required for performing each operation. Time standard obtained by means of exhaustive time study tests are used in scheduling the work to be done and as a basis of setting rates. Time standards are also used as a measure of the relative efficiency with which the work is accomplished.

The control mechanism of a planning department is the means by which the different physical problems entering into production are visualized. Such mechanism is nothing more or less than a substitute for the memory of certain persons. Follow up of materials, orders, production, and so forth, are necessary, and nothing should be left to the personal equation with the ever present chance of forgetting. Planning boards, perpetual inventory records, graphic charts, and so forth, are used for this purpose. It must be pointed out however that planning means "to anticipate." Planning means to form a picture of what should be done in the future, but the records showing progress of orders in the works is not planning. Planning should be the essential feature of the operating end of the organization and the necessary records should be secondary to it. "Red tape" or unnecessary system should be kept down to the very minimum.

It is just as important that the planning or production department be properly organized as any other department in the enterprise. The right man should be selected for its head and the various duties and responsibilities delegated to assistants. Cooperation between the men in the planning department and workmen in the shop, especially the foreman, is absolutely essential.

Planning, or production control in its specialized meaning, divides itself into three distinct lines of effort—routing, scheduling and dispatching. Routing has to do with issuance of orders, requisitioning of materials, and issuance of standard instructions. In other words, routing means to arrange all the details required for actually going ahead with the work. Scheduling has to do with the assigning of the work to the various departments or machines in the order or sequence in which they are required. Dispatching has to do with actually starting the work and seeing that successive operations are carried out according to schedule.

Planning departments are not introduced because they are new things with a certain amount of glamour connected with them. They are introduced primarily to increase production, to lower costs, to keep up quality, and to effect lower labor turnover. One manufacturer states that since systematized planning has been introduced his operation has been smoother; delays due to waiting for work, materials, tools, or instructions have been avoided; congestion of work in any one department has been reduced to a minimum; and men worked with better spirit.

Taking the classic "M" equation:
Materials + Methods + Men + Money + Management = Manufacture.
To this add "Planning" and the summation becomes:
Materials + Methods + Men + Money + Management + Planning = Successful Management.

ABSTRACTS

(Continued from page 62)

mately one square mile. In a three hour flight it is possible to make a continuous record of more than 250 square miles.
Aeronautical Digest.

She—Why did we come out here?
He—To look at the moon.
"Then let's go back and dance."
Cornell Widow.

BUSINESS IN PERSPECTIVE

(Continued from page 47)

the money markets and recently the stock market has taken a distinct upturn.

In 1920, costs had risen to or beyond the danger point, not in one or a few lines of business, but generally. However, business failures were startlingly low and there was much rejoicing, when, as a matter of fact, the small number of business failures should have been a danger signal. We must not forget again that there is a normal rate of business failure. A tremendous increase in prices, with costs lagging for a time, does not do away with inexperience, unwise use of capital and the common causes of business failure. These forces are always active, though they may be offset temporarily. The 1920 drop in prices, with costs lagging as usual, brought a cumulative crop of failures and business embarrassments. There can be no doubt that costs had risen beyond the danger line in 1920 or that many people were lulled into a sense of false security by the low rate of business failures and the prevalent feeling that business would always be good. Business perspective was again distorted.

Contrast the situation today. There is no tension in the money markets or credit stringency. Commercial paper rates averaged less than 5½ per cent in September and October. Seasonal requirements of business were met by the banking system without stress or strain.

With very few exceptions inventories are not dangerously large. Forward buying has been careful. The grief of 1920 made business men cautious in the matter of inventory commitments. There is no such maladjustment between production and consumption as existed in 1920. That goods are actually moving from producer to consumer is evidenced by recent freight records. Car loadings exceeded the million mark nineteen of the twenty-three weeks from May 26 to October 27 inclusive. During four weeks only the revenue freight record fell slightly below a million cars and each of these four weeks contained a holiday. It would be necessary to look a long while at the 1920 figures to find any such record.

In only a few industries—building, for example—did costs reach the danger point during 1923. These were usually dramatic instances that made good newspaper stories. "Sixteen dollars a day for plasterers" is a far more dramatic statement than this one: "An output of industry approximately that of 1920 has been attained [the first quarter of 1923] with a number of employes twelve per cent less than that reported in the earlier period, and with much less overtime." Labor inefficiency, it will be remembered, was prevalent in 1920.

The Present Level of Business

Business has not been on the depression level that many people tried to make us believe. It is not on the boom level that some people desired. It is not likely to be on a depression level until there is tension in the money markets, until inventories are excessive and costs have risen to the point where the margins of profit in all lines are cut so thin that business men curtail and cancel commitments. Nineteen twenty-four opens with the promise of good business.

Commodity prices—one of the best indicators of the ebb and flow of business—are not running wild. Sellers have kept their eyes fixed on what buyers will and will not pay. The general level of prices has shown a remarkable tendency toward stabilization. A firm or perhaps rising level of prices is in prospect for the first half of 1924.

The farming situation, about which so much has been said and gainsaid, did not start the expansion of business. Neither is it likely to put business on a depression level in the foreseeable future.

The foreign situation might be better, we all admit, but it has been with us for five years and now and then gives promise of improvement. At worst, it leaves business with a troublesome problem. At best it might be helpful in furthering business activity.

The business outlook is favorable and irrational fears are groundless. Caution in doing business is one thing; unrestrained fear is another. The business picture should be seen whole and in proper perspective during the months ahead.

COLLEGE NOTES

(Continued from page 64)

occurred on December 12, the entertainment being in charge of Professor Scherger. Motion pictures, refreshments, and smokes combined to make a very delightful occasion.

The Cycle

Said Ye Ed to Ye Ed, "Write me a line about *The Cycle* so that I may publish it in THE ARMOUR ENGINEER." "Perhaps" was the indefinite reply, but sometimes the indefinite materializes, and here is the reply.

"Dear Mr. Pierce:

"In regard to our talk of last week, herewith find the plans and the appointments for *The Cycle* of 1924.

"There has been a radical change in the design of the cover. In fact it has been so radical that we are afraid that the students won't believe it is the good old *Cycle* of by-gone years. The colored pages have been discarded due to the excessive cost of printing, and in lieu of these two-color cuts are being designed.

"We are planning to divide the class pictures into four groups this year and if this is to be done the members of the various classes must pledge their support to the staff that duplicate pictures of all the good looking sheiks be not taken. The Humor section is to be enlarged this year. To quote Professor Frend, 'This is the best start that the Humor section has had in years.'

"There are several other changes and additions which will not be disclosed at this writing for the book must contain something new and unheralded. As to the appointments:—*H. W. Regensburger* is the *Associate Editor; C. J. Placar* handles the *Athletics; W. J. McCauley* attends all the *social* functions; *E. R. Hubbell* worries about the *fraternities; L. D. Alper* is the official staff photographer; *C. G. Miller* writes '*Shoptalk*' (which is to be the best in years); *J. R. Frederick* is taking care of the *clubs* and *organizations; L. C. Senescall*, the *Art; H. P. Whitehill* is the *Business manager*, and *G. D. Day* tries to get the *advertising*.

Hoping that this satisfies your wants, I am

Literally yours,
A. A. Anderson, *Editor*."

Professors Harry McCormack and John J. Schommer were in attendance at the sixteenth annual convention of the American Institute of Chemical Engineers, held in Washington, D. C., December 5-7. Upon his return Professor McCormack spent some little time in his Senior and Junior Chemical Engineering classes, telling of the features of the convention. The convention body was accorded the privilege of inspecting all governmental scientific bureaus in Washington, and learning at first hand the useful and important work being conducted by the government.

Frosh Frolic

On Wednesday evening, December 5, A. I. T. discovered a number of embryo Barrymores. The Freshman class, assisted by the Orchestra, provided two hours' entertainment, and demonstrated that it is worthy material for Armour Tech. At the conclusion of the performance a judging committee composed of President Raymond, Professors Finnegan, Leigh, Phalen, and Hendricks, passed upon the relative merits of the acts. Although there were many good acts, the "Frosh Syncopators" were conceded to have the edge on the other contestants and were awarded the Prize Cup, donated by the A. T. A. A. The Frolic was under the supervision of the Dramatic Club, which deserves credit for the manner in which it executed its task.

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YOUTH AND THE NEW WORLD

(Continued from page 52)

before you, you go forth into a world, shell-shocked, torn with bitterness, calling out to every good Samaritan who will help.

I said a moment ago that the world's problems, broadly, were international, and could only be met by international solutions. Before I close I want to urge upon you the most searching examination, guided by the true scientific spirit, of the greatest experiment in international cooperation that the world has ever seen, the League of Nations. Study carefully, without prejudice, the Covenant upon which it rests. See how that Covenant is full of the democratic spirit and ideals of America. May I commend to you, if you haven't read it, "The Covenanter," written by Chief Justice Taft, President Lowell of Harvard, former Attorney - General Wickersham and Henry W. Taft, a former President of the American Bar Association? Here is a book, written by four leading republicans, let me say in passing, that will come to bear the same relationship to the Covenant of the League that the "Federalist" bears to the Constitution of the United States. Then, by all means, study the League of Nations in action. Test the validity of the principles of the Covenant by the record of the League during the past three years. See how three impending wars were stopped, examine the broad humanitarian activities of the League, follow the hundreds of thousands of prisoners of war as the League, represented by that noble viking of the North, Dr. Nansen, guides them back in safety to their homes, study the steady convalescence of Austria, sick almost unto death, as the League brings her back toward health—it's an absorbing epic of things done that will interest you and thrill you. And then I beg of you to spread the news—for it will be news—wherever you go, so that this country may come out of the fog of misrepresentation and prejudice into the clear light of truth.

The plain fact is we have had, for the past three years in this country, a closed mind in regard to the League of Nations. Here lies the great duty and the incomparable opportunity for the schools. Learning everywhere and always must bear the torch of freedom and of truth. That has been the glory of scholarship from the day the Greek students bore the new learning into western Europe and made it the foundation stone of the modern university. Out of the schools has gone the newer learning, as I said in the beginning, that has transformed the world. Out of the schools must now come the newer understanding that will bring the world into the ways of enduring peace.

So to the League of Youth I would commend the League of Nations. It is your contemporary, even if it isn't your creation. See that it is considered on its merits, as you insist that every other institution or fact should be considered. And, in conclusion, let me urge that you pay most careful heed to the purpose and to the performance of the League in respect to its effort to substitute the reign of law in the world for the reign of war. Do this in remembrance of the thousands of young men, the flower of the schools of all nations, who sleep tonight in soldier's graves. Last summer I was in Oxford and as I walked about the grey walls of Baliol and All Souls and Magdalen and all the rest, I saw the bronze memorials, bearing the names of those killed in the war. And as I beheld the graven lists of hundreds and thousands of England's best, I thought of the irreparable and incalculable toll that war had taken. What Miltons and Tennysons and Newtons of the future had gone to their death long before their time? The thought was staggering as I tried to conjecture the loss to the world in scientific knowledge, in human progress, in spiritual vision that these tablets of Oxford's sons might have recorded, could they have been set up a half century later.

Is it too much to hope that out from the schools will come the light and leading that will make forever impossible such commemorative records of sacrifice to war? In the place of war there surely can come a world of peace established on the firm foundation of justice and of understanding. For ages men settled private disputes entirely with their own hands. But all the time the reign of law was slowly establishing its sway. At last private vengeance everywhere had to give way to courts. That has been the evolution of men and communities within nations, and it is a denial of all progress not to believe that what has universally come within nations can universally come between nations. The torches lighted in the schools can hasten the coming of that great day.

SOCIETIES

(Continued from page 65)

sibilities, problems, and processes of manufacturing, of substances of vital interest to the Chemical Engineer. The talks had an added interest in that demonstrations followed along with the talk, bringing out certain facts not readily explainable by other means.

On November 1 the society was favored by the talk of Mr. MacLeod of the Sherwin Williams Company. His subject was a most interesting one: "Dye Testing and Blending." Mr. MacLeod showed by description and demonstration how various colors were matched, and how dyes are tested and blended to give a perfect match.

On November 15, Mr. E. Woxgold, Chemical Director of the Central Chemical Company, and a member of A. I. Ch. E., presented the subject, "Lithopone." This talk was of particular interest as it involved a description of the chemical analysis and processes, the purpose of which is to give a definite characteristic to the final product, namely, whiteness.

On November 29, Mr. O. W. Grossman, Vice President of the Kaine Manufacturing Company, and an Armour Tech Graduate, concluded the series of talks for the year. He presented an excellent description of different types of glue, and the requirements for each type. He showed how chemistry solves one of the big problems in the process of manufacturing an odorless, gelatinous glue.

All these lectures have been attended very well, showing the interest of the average student in the subject of commercial processes.

ARMOUR TECH DRAMATIC CLUB

After much work on the part of those interested the Armour Tech Dramatic Club was organized on October 24.

The following officers have been elected:

President, H. J. Luth
First Vice-President, E. J. Harrington
Business Manager, J. V. Hogan
Treasurer, T. J. O'Malley
Secretary, C. W. Lang
Custodian, M. R. Chambers

The purpose of the organization is to foster all phases of dramatics at Armour. The "Frosh Frolic" was given December 5, under the management of the club. In the next semester a vaudeville night is planned and a play for Junior Week.

Membership is open to all Armour Tech students and their cooperation will be appreciated.

A. I. T. MUSICAL CLUB

The Glee Club is now hard at work practicing for the Inter-collegiate Glee Club Competitive Concert to be given February 18, 1924. There will be thirteen clubs competing in this concert and the thirteen will render one song as a body. The song to be sung in this manner will be, "The Bells of St. Mary." The competitive song for this occasion will be Henschel's "Morning Hymn." The members of the Club are exceedingly desirous of achieving the coveted first place in this contest and are all on their toes, doing their level best. Another appeal for men to sing is being made, so if anyone is desirous of obtaining training in singing, this is his chance.

The band has some additions to it, namely, one BB tuba, two mellophones,

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SOCIETIES

(Continued from page 72)

and one baritone. These were purchased by the Athletic Association, and their addition has been a great help.

The Orchestra and Glee Club, together with Mr. F. E. Brown, entertained at the Armour Mission, December 12, 1923. Several dates have also been arranged for the holiday season.

ARMOUR TECH RADIO CLUB

The Radio Club holds its meetings regularly every other Thursday in the Physics Lecture Room. At the beginning of the semester the meetings of the A. I. E. E. and the Radio Club were held at the same hour. Since then, arrangements have been made for the two organizations to meet on different days. This enables members of the A. I. E. E. to attend the Radio Club meetings. Under the new schedule the Radio Club meets on the second and fourth Thursday of each month.

It has been the effort of the club to secure good speakers for its meetings. The meeting of November 15 was addressed by Mr. L. M. Clausing of the Chicago Radio Laboratories, engineer and designer of the Zenith Edgewater Beach station WJAZ. Mr. Clausing's talk was very interesting and instructive. It included a number of topics such as microphones and power amplifiers and told briefly of some of the problems encountered in broadcasting voice by radio phone.

The meeting of November 22 was a special business meeting. A resolution of affiliation with the American Radio Relay League was read and accepted. A committee was appointed to draw up a new constitution for the club.

We were very fortunate on December 15th in having Mr. K. E. Hassel, I. R. E., of the Chicago Radio Laboratories, who talked on receiver design. Mr. Hassel's remarks were applicable to both amateur and broadcast receivers. His talk gave many valuable points on the construction of coils and and condensers.

The attendance at this meeting was the largest on record. Sixty-five students representing all departments of the school were present and registered their interest by remaining through most of the lunch hour to hear the finish of the lecture.

QST, the official publication of the American Radio Relay League will soon be available in the library

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Chairman .....D. E. Richardson
Secretary.....J. S. Farrell
Treasurer.....J. O. Aalberg

The Armour Branch of the American Institute of Electrical Engineers hold their meetings the first and third Thursdays of each month at 11:30 A. M. in the Electrical Lecture Room. We have been fortunate this year in obtaining good speakers, many of them being leaders in the electrical engineering field. At the first meeting of the year we pulled ourselves together with our new officers and started to lay out a program for the following meetings. We were especially fortunate in having Professor Snow to help us along this line. At the next meeting Mr. E. F. Bracken, General Inspector of Sub-Stations, for the Commonwealth Edison Company, spoke to us, his subject being "Electricity, From Coal Pile to Consumer." Mr. H. A. Almendinger at a later meeting gave a very interesting talk on "Automatic Train Control." Many other instructive talks have been given and many more are being planned. On December 20, we gave our first smoker of the year and it was *some* affair. All those present voted it the best ever. There were a number of good speakers and plenty of smokes for all.

We now boast a membership of about forty but are desirous of making the organization 100 percent of the electrical class. Those who are not members now, are earnestly invited to attend one of the meetings. We feel sure that you will not hesitate in becoming a member of the American Institute of Electrical Engineers.

GUN AND BLADE CLUB

The Club has a live wire for a President this year, John Hogan, a hero of the late war, who received two citations along with a bit of lead and a gallon or so of gas . . . 'tis proof enough that you can't keep the Irish down.

Our Secretary-Treasurer is Treff, our "Shavetail" friend and our Sergeant-at-Arms.

The Club turned out in full strength for a smoker this year at which we fought the war all over again and mapped out our course for the next.

On Monday, December 17, our loyal friends the Elks, the men who never forget, gave us our annual banquet. It was a wonderful affair.

We are still working on the tablet which is to be placed in the lobby of the main building. This tablet is to bear the names of all the war vets who have attended Armour Tech, and we hope to have it in existence soon.

DEBATING SOCIETY

Recent agitation has resulted in the organization of a debating society. At its first meeting the following officers were elected:

President, O. Unger
Vice-President, L. Oblinger
Sec'y-Treas., J. H. Bailey
Debating Manager, I. A. Deutch

The purpose of this organization is to foster and develop the art of public and extemporaneous speaking among the members of the society. Membership is open to any student in Armour Tech.

A series of discussions has been arranged. The first of this series will be upon the following topic, "Resolved that Engineering Colleges Should Offer One Course in General Engineering to Undergraduate Students, and that Specialized Engineering Courses Should Be Given to Graduate Students Only." This discussion will occur shortly after the Christmas holidays. All students interested in debating are cordially invited to attend this meeting and to take part in the discussion. The date on which this meeting will be held will be posted on the bulletin board.

COLLEGE NOTES

(Continued from page 71)

Captain John W. Gorby presented some of the problems of modern transportation, now being studied by the National Transportation Institute, at our assembly of December 18. He also outlined the principles of success in a very convincing manner.

Major General Milton Foreman gave an interesting talk to the students on November 12. His topic was "What does Armistice Day mean?" Major General Foreman is a staunch advocate of the policies of Washington and Lincoln, and his speech was in accord with their principles.

When the Committee on Building Construction of the National Fire Protection Society fulfills its aims it will be possible to contract for building construction which will be standard throughout the United States. This work is now in progress. The committee meeting held in New York on November 22 to 23 was attended by Professor C. E. Paul.

THE GRADING OF COLLEGE STUDENTS

(Continued from page 58)

(b) English which unjustly has the reputation of being easy has less A's, less B's and more E's than Mechanics I.

(c) Physics which is the bugbear of many, stands fifth in failures.

(d) Kinematics, which is taken by a selected group who are adapted for it, shows that fact in the high percentage of A's.

(e) As compared with other courses Descriptive Geometry has too many B's in proportion to the C's.

The above comments are not intended to be destructive. The whole purpose of the article has been to show what a tremendously intricate thing marking is when one attempts to consider even moderately scientifically just a few of the factors.

The human being is a multi-partite thing, and when assessed by a multi-partite judge the result is sure to be intricate. Nevertheless students will forever, no doubt, demand a simple ordinal grading system, faculties will try to operate one, and both students and faculty will ever find fault with it.

THE SLIPSTICK

(Continued from page 69)

The mission towers upon the left,
Main building on the right;
While filling up this canyon cleft,
Stands one forlorn arc light.

(We wanted to include the mail box, but it wouldn't rhyme, unless with Wallcox.)

And further down the street you see
Our cloistered Chapin Hall—
The Palace of Machinery
By far surpasses all.

("Cluttered" would be more accurate than "cloistered", but less poetic.)

Nor canst forget the spreading green
Of glorious Ogden Field,
The victories that fence has seen—
(Defeats are not revealed!)

(And of course no school song is complete without a stanza like the following:)

So here's to A. I. T., my boys,
So here's to A. I. T.
For all the odors and the noise,
It still is A. I. T.!

THE ARMOUR GUIDE BOOK

The Bulletin Board—A collection of all the notices you should have read last week and didn't.

The Main Office—Where you are summoned by special request for matters unnecessary to mention.

The Library—A room dedicated to the continual conversation of upper class men.

The Memorial Window — Artistically considerate of the lack of beauty outside, and substituting man's own handiwork in place of the combined efforts of Nature and the Rock Island Lines, consolidated. It will be noted that the window also bears quaint expressions of a now *passe* philosophy.

Science Hall—A room dedicated to class meetings and other unimportant occasions.

The Elevator—A slower means of interfloor transportation than the stairways.

Well might the pictures of past classes that adorn our fair walls be termed "The Grim Reminders of Former Wars."

EDITORIALS

(Continued from page 61)

"CHICAGO" POLITICS IN THE DEPARTMENT OF THE INTERIOR

Current engineering periodicals and reports of fall meetings of the various engineering societies almost all contain some reference to the recent action of the Secretary of the Interior, Hubert Work, in removing from office Mr. Arthur Powell Davis, Director of the Reclamation Service, and one of the leading engineers of the country.

In substance the charge against Dr. Work is that for purely political reasons he has summarily ousted one of the most efficient engineers the Reclamation Service ever had in its employ, replacing him by a political friend, who has done absolutely nothing to warrant the confidence that seems to be placed in him.

It seems also that the reason, or excuse, given by Secretary Work, that a business man was needed for the position —inferring that Mr. A. P. Davis is not a business man — was entirely without grounds.

We are not acquainted personally with any of the gentlemen in question, but from the fact that so many of the engineering societies and publications have taken up the agitation we are thoroughly satisfied with the evidence as presented. Spoils politics may pervade almost any other branch of governmental service, and may appear not greatly to impair governmental functions, but when the question becomes one of selecting a scientist or an engineer upon a basis of political amity, rather than upon that of personal ability, it is an entirely different matter.

If a Hoover, a Steinmez, or a Michelson can be obtained at will from the ranks of the political friends of any party, why don't we have more such men?

Aside from the injustice of this particular case, Secretary Work's action publicly places the entire profession in an unjust and unfavorable light, for the charge is of a general nature and is applicable in the public mind to the engineer in general.

Swift joint action in the form of protests from engineers all over the country has resulted in the appointment of an investigating committee to determine the real reason for the present situation in the Reclamation Service. Engineers are eagerly looking forward to the report of this committee, for it is believed generally, that facts will disprove conclusively the statements to which Secretary Work and his associates have given so much publicity.

ATHLETICS

(Continued from page 66)

the organization is well under way. An interclass meet was held in order to bring out any of the latent talent which might have otherwise remained undiscovered. This meet served its purpose in that it brought out the new men and gave Coach Smith an inkling as to what he has in stock for this year. The aspirants for mat honors this year who appear likely to be seen in action are Giemer, Nissley, Mannhof, Haller, and Karakes. Some of the classes are as yet open and should any bright and shining light appear the aforementioned men may have to step some. The outstanding find of the class meet was Karakes who has had considerable experience at this game and should have no trouble in holding all comers in the middle-weight class. The exact outcome of the meet, if determined on a point basis for matches won, went to the Freshmen. However, as the Sophs had several men on hand with no one to work against them, they claim it on this basis.

Anyone desiring a good work-out and a little instruction in the manly art, should drift around some Saturday morning. If a young gentleman, Pylos by name, happens to be in the vicinity why both of the aforesaid articles are assured. Just a tip on the side, however, Pylos used to be a sparring partner of the w. k. Pancho Villa who is one of the fightines' young fellows who ever drew on a glove.

PROFS

Profs is those which:

Talkssodamnedfastthatyoucan'ttakeanote.

Spend three-quarters of an hour and one box of chalk explaining, and then after you've copied four pages of notes, tell you that the stuff is not important.

Wear red neckties and horse collars.

Wait until you're jammed with work and then throw a quiz.

Think that their course is the only important one that you are taking, and hand out problems as if they were giving away German marks.

Tell you not to bone for the exam because it will be general, and then ask you if you agree with the statement on page 247.

Give you the Fs and the others the Cs and Bs.

Call the roll the day you cut.

—*Mass. Tech. Voo Doo.*

She—I hear he drinks something awful!

He—Yeah, I tasted it.

—*Northwestern Purple Parrot.*

TRY THIS ON YOUR CHIEF DONATOR, YOU GOLF FIENDS

Dear Dad:

The Math Course here is pretty hazardous, the best I could make was 95. That is pretty rotten, I know, but you might be pleased to know that I made the Chem., Drawing and Railroads courses in less than 60. I think I can reduce them if you will send me more money for clubs.

Minnesota Technolog.

The Armour Engineer

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THE
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TELEPHONE ENGINEERING
WITH SPECIAL REFERENCE TO PREPARING FOR FUTURE EXPANSION

By
ALBERT P. ALLEN

Commercial Engineer, Illinois Bell Telephone Company

TELEPHONE engineering, like all forms of specialized engineering, consists of studying the experiences of the past and applying intelligently and economically the results of such experiences to the problems of today, and to the plans for the future. The handicap to the engineer who enters a new field, by which I mean a field which has not had the benefit of considerable actual experience, is well demonstrated whenever we see the progress of any new art or important invention. Take the successive designs of the steam locomotive or of the automobile, from the first commercially successful design to its present form, as developed by successive groups of engineers, and it is easily seen how much the slow attainment of ultimate efficiency and economy of design is due, not so much to lack of knowledge of the scientific elements involved, as it is to the lack of sufficient practical experience in its use and with the actual production methods which can be developed only by such experience.

If we take the telephone receiver by itself we seem to find a contradiction of the above general statement, for the first telephone receiver designed by Alexander Graham Bell has passed through less noticeable changes perhaps than has any similar new and important article of modern usefulness. If, however, we take the telephone business, and especially telephone equipment as a whole, the early work of the telephone engineer looks as odd today as do the first models of the steam engine, of the electric motor, or of the automobile. Of course it must be remembered that the present day freight locomotive, the present day turbine generator, as well as the present day telephone multiple switchboard, would have been practically useless in the early days of the respective industries of which they are

Mr. Albert P. Allen.

now so important a part. This is not because their general principles of efficient design would not have been useful from the start, but because their present development, in size necessary to handle today's large volume of business, would have had no field for economical operation until many years after the industry started.

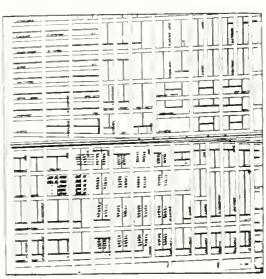
While no engineer has to study the past except to secure knowledge and experience, the engineers employed in the various industries differ greatly as to the portion of their work which has to be applied to the problems of today, or of the immediate future, and the portion which they have to spend in studying the more or less distant future. This division of the work of the engineers is, of course, usually proportionate to the permanency and expected life of the plant which they are engineering. Sanitary engineers who lay out the water supply and sewerage systems of our large cities are among those who have to look the farthest into the future. On the other hand, engineers who design automobile parts and similar items of short and changing life, are very little concerned with what may be taking place twenty or thirty years from now.

Of all the so-called public utilities which operate in our large cities the Telephone Company is probably the one which has found its economical construction and operating problem to depend most upon estimates of the volume and kind of service which it will be rendering, not merely five years, but even twenty years in the future. In fact the making of such long term estimates is now an accepted practice and part of the regular routine of all large telephone companies. There has been a gradual development of telephone engineering, which is the direct result of experience and of the tremendous growth which the telephone industry, along with other public utilities, has had up to the present day.

It may be interesting to take Chicago as an example to show what this growth has been. Forty years ago, or on January 1, 1884, there were less than 3,000 telephones in Chicago. Ten years later there were 10,218. In the next ten years the total reached 76,147; in 1914 it was 348,417; and on the first of this year it had reached 691,545. In 1900 there were 26,661 telephones in

service in Chicago after some twenty years of operation. Last year the net gain in Chicago was 52,851, or two times the total number in service after more than twenty years of operation. The number has doubled almost exactly in the last ten years. In only a few years more we expect to have fully a million telephones within the city.

The two items which make it necessary to know as accurately as possible, not only the total number of subscribers to be served, but also their exact location at any future time, are first, the fact that each telephone subscriber has to be furnished with a circuit connecting him with a central switching office, and second, the fact that the transmission requirements put a limit on the economical distance at which the subscriber can be located away from the central office. These two basic requirements are of course still further complicated, or at least emphasized, by the fact that central office locations, once established as wire centers with their radial system of underground conduits and expensive cables, cannot be moved from one location to a more desirable location without very great expense and loss of investment. All central offices have to be connected for intercommunication by means of large and expensive groups of trunk circuits, over which it is still more costly to maintain proper transmission requirements, which would also have to be abandoned, or greatly changed, if the central office locations were changed. In other words, if the future of the business in a large city could not be rather accurately pictured in advance, the central office locations, together with the complicated net-work



Future service requirements are estimated for each city block over a period of years.

of underground conduits and trunk lines could not be economically located, and in a few years the necessary cost of giving the service to the public would be very much greater than would be the case if such knowledge were available and had been used to full advantage.

Telephone engineering has many branches some of which are highly specialized, and in the aggregate requires a knowledge, to a greater or less degree, of almost every known branch of science. We might perhaps eliminate astronomy; but there are many branches, such as metallurgy and chemistry, to say nothing of psychology and

It is usual to assume that an article on an engineering subject will be dry, that it will present facts and figures but will be devoid of any but professional and scientific interest. Technical writing has become almost synonomous with dryness.

Mr. Allen's article is a marked example to the contrary. It is engineering without a doubt, and its subject is truly a technical one. But in the method of presentation, as well as in subject, we have difficulty in imagining anything of more professional or general interest.

It is to be regretted that the very nature of engineering and engineering education has a tendency toward the cultivation of the "text book" style. Interest as well as clearness should be the aim of exposition, and when engineers recognize this fact, their technical books, articles, and reports will be more widely read.

political economy, which have to be followed to a much greater degree in connection with the telephone business than the ordinary citizen probably is aware of. The engineering of mechanical structures in connection with buildings, conduit systems, pole lines, and even subways under rivers, calls for the work of a great many mechanical and construction engineers. The switchboards with their thousands of delicate relays, signals and other parts, call for the service of the most experienced machine designers; while the complicated and extremely numerous electric circuits used in connection with both the manual and machine-switching, or so-called "automatic" systems, to say nothing of the circuits which have been developed in the extension of long-haul aerial, and cable talking circuits, require the service of the most highly advanced electrical engineers. In the manufacturing field which has been developed in connection with the telephone industry almost every known material is used, and research work is carried on continuously in the endeavor to secure materials, or better materials, or to reduce the total cost of the required equipment and apparatus.

As in all other industries, the telephone business necessarily started without telephone engineers, and the first engineers were employed mainly to take care of the design and construction of the physical plant. They were not telephone specialists or authorities, but were necessary assistants to the managers of the business. As the business advanced, however, it soon became apparent that not only were there serious existing problems to be met, but that these problems involved a variety of activities for which specialists had to be secured or developed. Therefore, along with the rapid growth in subscribers, there was a rapid growth in the number and variety of telephone engineers. For a long time, however, their recognized function was limited almost entirely to the development of physical parts of the plant, while the executive officers retained direct control over types of service to be given, rates to be charged, public relations, and other such non-physical problems of the business.

With the growth in number of telephones in the area served by each

This industrial map shows existing manufacturing districts in black and districts provided for industrial expansion in gray.

company there came the natural complication in the operating methods. As a consequence, about twenty-five years ago, it was recognized that the problems of the operating room, the proper assignment of forces, the proper methods of operation, the studying of improved switchboard functions, all of which represent problems apart from those involving the designing of physical parts, should be seriously studied from an engineering point of view. The men who were assigned to these special duties might have been called "efficiency engineers," but they were called and are still called "traffic engineers."

since they have to do with the perfecting of the service or operating work in the Traffic Department.

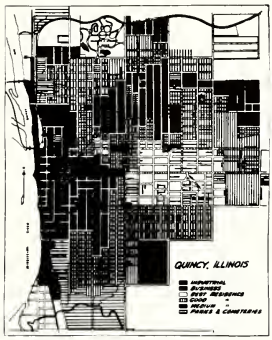
It was not until some time later, or about fifteen years ago, that the engineering problems of the Commercial Department were set apart as properly forming the basis of a third branch of telephone engineering known as "commercial engineering," which is now well established in most of the large companies. It is the duty of the Commercial Engineering Department to make the forecasts of the probable growth of the business. It studies the proper rate structures and rate levels which will allow the company to secure sufficient revenue and at the same time produce the desirable number of subscribers in relation to the population, and which will allow each subscriber to receive the service he needs at the proper relative charge which should apply to that particular kind and quantity of service. In addition to this the commercial engineers make a study of commercial practices in order to help maintain commercial expenses at a minimum without sacrificing the necessary service to the public.

In carrying out the first of these functions, namely that of forecasting the future, all available data in connection with building development, rental classifications, nationality of population in various sections, transportation facilities, natural industrial areas, city zoning, ordinance restrictions, and other similar matters are carefully checked, tabulated and studied. The population statistics, their trend and probable future, are given special attention; and the distribution of the population by small subdivisions of the city, and any possible migration from one part to another, is carefully noted. In Chicago for instance there are zones, with the Loop as a center, within which the population of the city as recorded by the Census has been, and still is, steadily decreasing, the growth of the city as a whole having occurred entirely in the areas lying outside these zones. This fact of course controls the development of telephone service in Chicago in so far as residence service is concerned. As to business telephones, however, such a change is usually caused by the expansion of manufacturing and industrial life, which makes it necessary to study all these areas very carefully in order to see whether the loss in residence telephones will be equalled or perhaps greatly exceeded by the gain in business telephones.

The modern skyscraper and large office building is a problem in itself and has to be given particular attention by the telephone engineers, not only as to the total number of stations to be served, but as to the best means of providing circuit facilities to any spot within the building where a tenant may desire to have a telephone placed. In most cases such large buildings have direct cable connection with the nearest central office.

In the following paragraphs is outlined a brief description of the steps usually followed by the engineers in preparing what is known as a long term commercial survey of a telephone exchange area like Chicago.

1. *Selection of the Survey Area.* This involves deciding upon the area in which the present development makes it advisable to study each block, also



Every district in a city is classified when a long term commercial survey is made.

determining the adjoining areas into which future development may extend and which therefore should be included in the survey.

2. *Estimates of the Future Population.* The future population is estimated (a) for the incorporated city, which usually forms the greater part of the survey area; and (b) for each of the communities which are tributary to the city. The two estimates are then combined as the estimate for the entire survey area.

3. *Distribution of Estimated Population.* The estimated population for the incorporated city is tentatively distributed (See 12 below) among its minor civil divisions, such as wards, or precincts. It is usually the case that past population statistics form different census reports are available for wards or precincts. This distribution of estimated population is not necessarily a final distribution, as explained later.

4. *Record of existing Subscribers and Service, by city blocks.* This record is obtained from addressograph slug impressions of the auditor's billing records, which give the necessary information as to address and class of service, a separate card being provided for each subscriber.

5. *Outline of Industrial and other Unpopulated Areas.* Industrial areas usually can be readily outlined, and such areas should be laid out with provision for expansion. Also large parks, cemeteries, etc., should be outlined, as not subject to telephone development.

6. *Division of the Survey Area into House Count Sections.* The survey area is divided into "house count sections" in such a manner that the section boundaries coincide in all cases with the ward boundaries and follow census enumeration district areas as closely as practicable. The house count sections are numbered for convenience in summarizing.

7. *Preparing Field Forms for use of Data Men.* The field forms, or loose leaf note books, are prepared for use by the data men by writing in the ward, section and block numbers, and the block street boundaries, in the spaces provided. The amount and class of telephone service for the block as a whole is also shown.

8. *Collection of Field Data.* A preliminary character analysis is made of the wards to determine how many "homogeneous market areas" are contained in each. This market area layout in the wards is tentative and is used mainly as a guide for the field men.

The field data collected consists of (a) the number of residence premises, classified by houses, flats and apartments; and (b) the number of business premises, classified into four or five general groups. Tabulation of residence and business premises is also divided into "occupied," "vacant" and "under construction." Vacant land is tabulated by building sites, a building site being the average sized lot used in that block for either residential or business purposes, as the case may be.

9. *Estimate of Ultimate Families, Business Firms and telephone development.* When a field man is assigned to a ward or precinct he is given all the statistics of past and estimated population for that area and also a character analysis, as expressed by the homogeneous market area divisions. During the collection of the field data for any block, he has had this information in mind and has observed the tendency in building operations, with particular reference to whether the block is building up with single family houses, flats or apartment buildings, and to what extent local business buildings may occur.

Giving due consideration to these things, he is ready to estimate how many of the vacant building sites will be improved, with the type of building and how soon this building will prob-

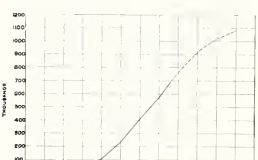
ably occur. This permits him to estimate the total number of residence and business premises for the three, six and eighteen year periods. At this time he calculates the ratio between residence premises and residence stations, and the same for business premises. He carefully analyzes the block to determine whether its character, from a telephone standpoint, will remain the same, improve or change to a poorer class. The results of his analysis are set down as telephone development for the estimated periods and premises.

10. *Study of Industrial Development.* The study of the industrial development is assigned to field men particularly proficient along these lines. After laying out the area occupied at present for industrial purposes, a careful investigation is made to determine the natural advantages and other factors which have been responsible for this development. Information is obtained from each of the industrial concerns as to the type of industry, total number of employes, divided into male and female, and further subdivided into skilled and unskilled. From some responsible officer of the concern an estimate is obtained as to the permanency of the concern and its plans for future expansion and number of employes. After collecting this information and studying the reasons for the location of industries, the ultimate industrial area is laid out. This may involve including adjoining tracts of land, or possibly laying out areas at present not devoted to this use but which have the advantages required for industrial development. A check is also made of each concern as to the amount and class of telephone service now used, and whether or not the service is sufficient for the requirements. For each of the larger concerns the ultimate telephone requirements are estimated, especially where Private Branch Exchange service is now, or may be, used.

11. *Study of Central Retail and other congested Business Areas.* Recognizing the tendency towards centralized retail districts in the larger cities, special methods are necessary in studying them. History shows that these centralized retail districts owe their location to, and have their beginning from, the location of some public building, such as the county building, city hall, or post office. The retail district grew up around this common meeting place as a nucleus and, as the district became more and more popular as a retail trading post, it expanded until we find within this total retail district numerous sub-areas each occupied almost entirely by concerns dealing in the same kind of merchandise. An example of this occurs in Chicago, where all the large department stores are located within six blocks on one street. This also occurs in other large cities in the United States. There is a strong tendency for concerns of the same type to locate side by side, with a fringe of smaller concerns handling an allied line of goods.

Also there is usually an amusement district, containing legitimate vaudeville, and moving-picture theatres. Scattered throughout the area, at strategic points, are found hotels. A study of the centralized retail district therefore involves outlining the areas in which are grouped similar concerns, and carefully studying its possible expansion.

Our experience dictates that large, modern buildings should be studied separately. The information gathered on such a building includes (a) the dimensions of the ground area, (b) the number of floors, (c) the number of tenants for each floor, (d) the class of service for each tenant, and (e) the general tendency as to the number of occupants in each of the upper floors. The results obtained from this study of the building are expressed in terms of square feet of floor space per station; and whenever a new building is to be erected it can be compared with one already occupied and the actual number of square feet of floor space per station can be used as the basis for estimating the telephone requirements of the new building.



Illinois Bell Telephone Company growth of telephone stations in Chicago.

12. *Summarizing Field Data.* As soon as the field data has been collected for an entire ward it is summarized by the office clerical forces. The field estimate of ultimate families is translated into terms of population by deciding on the number of people per family in that ward for the ultimate period; this figure being obtained by studying the past figures on size of family, as shown in the various census reports. The field estimate of population is then compared with the tentative estimate described under (3) above; and, if there is any considerable difference, a further study is made to determine what population figure should be adopted.

In the case of a multi-office exchange, a further summary is made of the estimated total stations for the office areas within this exchange, and a graphic chart is prepared showing past stations and the estimated total stations for the various future study periods. This gives a very good check as to the reasonableness of the estimate. After the complete summary of the field data has been made for the ward, the homogeneous market areas for this ward can be laid out more definitely than before and the necessary corrections, if any, made. This market area lay-out is accomplished by assuming that the average telephone development in the block is a fair indication of the economic status of the people living therein.

13. *Distribution of the Estimated Total Stations by Classes of Service.* The general theory of distribution of stations by individual and party lines is based primarily on rate treatment and past rate schedules are responsible to a large extent for the present distribution among the various classes of service. The next step therefore is to determine the general policy of the company towards party-line service, especially as to whether 4-party residence service will be encouraged or discouraged. This is sometimes very difficult to decide definitely, in which case it is necessary to assume the amount of party-line development that may be expected. This is usually expressed in terms of "per cent party-line of total stations."

In areas that now have a relatively high party-line development, but where the class of the area is improving, the future estimates of course reflect this tendency. In areas that show indication of degrading to a lower economic scale through changing character of population, due to nationality or other reasons, a larger party-line development is estimated in the future than at present. After the total stations have been thus distributed among the classes of service, the corresponding number of lines is computed by using a factor consistent with the expected party-line development in that area.

14. *Final Report.* The final report is a brief past history of the area, a statement of the present conditions and a complete explanation of our future estimates. Attached to this final report are charts, maps, summaries and such printed descriptive matter as is available and valuable in connection with the study.

As a field for the young engineers, the telephone business is so large and has so many ramifications, involving all those branches of science which are ever connected with industry, that it appeals strongly to men of widely vary-

(Continued on page 114)

NOTES ON AUTOMOBILE BRAKES

By
DANIEL ROESCH

Associate Professor of Gas Engineering

Foreword

THE subject of brakes has always been and always will be of major importance in the design and performance of automotive vehicles.

The matter has become one of the leading topics of discussion within the last year, among engineers and car users. An inspection of technical literature pertaining to the automobile shows that a similar interest in the subject of acceleration preceded the present importance attached to brakes and deceleration problems. In surveying recent technical literature and recent newspaper advertisements it is of interest to note the different manner in which the arguments are presented by each. We find the former usually stating the facts based on theory, design, practical operation, and tests, with the reader forming his own conclusion. The latter has the conclusion stated or implied, and often quotes desirable extracts from technical articles. In the latter we find full page advertisements defending the two-wheel brakes with the findings from tests that four-wheel brakes are unnecessary, mechanically impracticable, and dangerous in the hands of unskilled drivers. On the other hand, the four-wheel brake convert shows that his stand is taken because of superior qualities not admitted by the former. The car with a single brake also has its merits emphatically explained. After seeing these arguments one readily agrees with the saying that sparrows are not hunted with sixteen-inch guns.

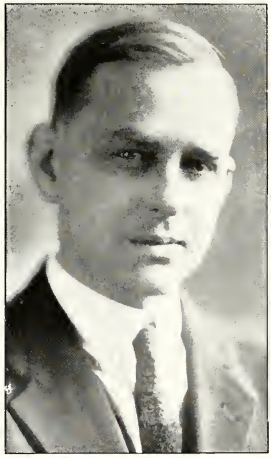
The purpose of this article is to show brake requirements, and the performance obtainable with different systems. Representative types are discussed and data pertaining to brake design are given. The subject of highway capacity and the influence of various conditions upon stopping distances has been given attention with the thought of legislative requirements.

Function of Brakes

Brakes are needed:

(1) To reduce car speed and actually stop the car on level roads or on a grade.
  (a) Absorb translational energy of vehicle.
  (b) Absorb flywheel effect of parts.
  (c) Equalize grade effects.
(2) To regulate the car speed when the car is influenced by grade.

A discussion of each of the above items is given later.



Professor Daniel Roesch.

Good braking produces a sense of liveliness in a car when combined with good acceleration. The stunt of demonstrators in releasing the accelerator and then stepping on it gives the prospect a feeling of "pep." When this is done at 40 m.p.hr., it produces the false impression that the car has a much greater maximum speed than 40 m.p.hr., even though this *is* the maximum. The reason for this is that when the throttle is closed the car decelerates due to engine braking and wind resistance. This may be at the rate of 2 or 3 ft. per sec. per sec. or more. Opening the throttle removes this deceleration even though the actual speed of the car is not increased. Changing from deceleration to constant speed is, relatively, acceleration in the mind of the rider, and is interpreted by a receptive imagination, as changing from a constant speed to acceleration.

Requirements

Requirements of performance demand quick stopping, and a fixed stopping ability may become legislative requirement unless cars universally have this ability to such a degree as to make legislation unnecessary. Some of the highly commendable work of the Bureau of Standards along these lines has been made available in a number of papers by Doctor H. C. Dickinson and Doctor W. S. James, physicists. The work includes the development of methods of inspection and special test instruments, with recommended procedure. Treatment of this work shows careful, unbiased consideration of the car users' and pedestrians' viewpoint.

In the case of inspection for braking ability, for example, we find a comprehensive analysis reduced to simple readings of acceleration, without the particular necessity of obtaining the exact car speed. The work includes a development of a rugged instrument particularly adapted to the work. Analyses and tests of the other phases of brake and automotive problems have been of inestimable value to makers and users of such equipment. These show a high caliber in the matter of practical deductions as well as in complete theoretical analyses. Even a casual knowledge of the benefits show the advisability of practical endorsement of this work, with added governmental appropriation in excess of one cent per year per ten cars in use.

Requirements of good brake design (H. M. Crane, S. A. E. *Journal*, Nov., 1923, p. 395) have been treated under the following considerations: (1) smoothness of operation, (2) retardation proportional to pedal pressure, (3) absence of self-locking, (4) durability, (5) ease of adjustment and operation, (6) force available to operate, (7) simplicity, (8) minimum disturbance due to body movement.

Vehicle Energy and Its Distribution During Braking

To reduce the speed of a vehicle having velocity it is necessary to absorb some of the energy stored in the

vehicle. The energy which a vehicle possesses includes:

(a) Level road conditions.
  (1) Translational energy of car $= \frac{1}{2} Mv^2$ (in ft. lb.).
  (2) Flywheel energy of rotating parts $= \frac{1}{2} m \omega^2 r$ (in ft. lb.).

(b) Inclined road conditions.
  (1) Energy as above.
  (2) Potential energy $= W \times h$ (in ft. lb.).

The dissipation of the energy in a moving vehicle is primarily by means of brakes, which produce a reaction upon the road or rail surfaces. For maximum braking effects, therefore, the maximum values of adhesion or "friction" coefficients of the wheels are necessary data, and determine the maximum possible retardation. Steel rails and iron wheels have been considered as having a coefficient of adhesion of 0.20 (Jounger, *S. A. E. Bulletin*, Nov. 22, 1916).

The force in lb. required for retardation is $f = ma$ (the product of mass and acceleration) and at the point of slipping is equal to the weight $\times$ 0.20. This corresponds to a maximum 'a' of 6.4 ft. per sec. per sec. for braking on all wheels. In the best stopping record, as reported for a Pennsylvania train moving at 60 m.p.hr., the distance was 1000 ft., the time of uniform deceleration was, $1000 \div [(60 \times 5280) \div (2 \times 3600)]$, or 22.7 sec., and the average retardation was $[(60 \times 5280) \div (3600)] \div 22.7$, or 3.88 ft. per sec. per sec. Other test results for similar conditions show that the coefficient of adhesion may vary in practice from 0.12 to 0.32.

An automobile tire may be considered as having a coefficient of adhesion of 0.60, although considerably higher values are undoubtedly attained. Considering all the weight to be on the braking wheels, the maximum retardation computed from this effect is 19.2 ft. per sec. per sec. (coefficient = 0.60). When rear-wheel brakes alone are used the maximum value of 'a' is 10 or 12, and with front-wheel brakes alone may reach values of 12 to 14, depending upon the weight on the braking wheels. The difference in the two latter conditions is caused by the wheel-load transference due to inertia effects during deceleration. This factor transfers about 200 lb. from the rear wheels to the front wheels when decelerating at 10 ft. per sec. per sec. with a 3000-lb. car. The amount transferred in a given car is proportional to the deceleration, as will be shown later. Since the energy of a moving vehicle, or one on a grade, is proportional to its weight, it follows that with similar and equally efficient brakes, the heavy car can stop in the same distance as the light car. Popular conception often differs.

Within the last year that portion of the American Public which interests itself in the automobile—which means nearly everybody—was placed all agog by the introduction into the country of four-wheel brakes as standard equipment on pleasure cars. Arguments pro and con, changes and counter changes, both of a bona fide and a publicity seeking nature, were hurled back and forth, resulting in the attraction of considerable attention and interest to the subject of braking and braking methods.

Also within the last year the adoption of the automatic traffic signal system on Michigan Boulevard of our own fair city, has concentrated popular attention on motor vehicle traffic and the capacity of highways.

In "Notes on Automobile Brakes," Professor Raesch has accomplished the difficult task of combining these two topics of the hour. The discussion is complete and technical, yet very interesting and readily understandable even to the layman.

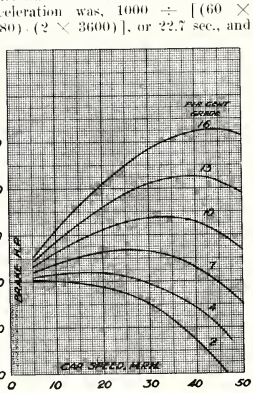


Figure 1. Power absorbed by brakes in maintaining constant speed down grade, on various constant grades.

The values of 'a' given in the preceding paragraph neglect rolling resistance of the car, wind resistance, and rotational energy of vehicle parts. The effect of these factors will be taken up later. It is well to note that the force of retardation acts tangentially on the tire at the road surface, and this may have an influence on the road adhesion in the case of a flexible automobile tire. The greatest effect will occur with severe brake applications, when the tangential force may reach 600 lb. or more per tire of a passenger vehicle. Very high records of deceleration may be favorably affected by increased road adhesion and increased tire losses occurring at the time. This characteristic may explain records of exceedingly short stopping distances not reconcilable with the usual figures given for tire adhesion.

Energy Absorption on Grades

At the top of a hill a car has potential energy if stationary, and potential and kinetic energy if moving. The usual problem is to maintain a constant speed during decent, *i. e.*, to absorb the potential energy at the same rate as it is being released. Using the rise in ft. per 100 ft. of road surface as the grade in per cent, the component of force on the car due to grade will be its weight times the per cent grade. The resisting forces holding the car at a constant speed are the brakes, rolling resistance of the car, and wind resistance. The net braking effort in lb. is:

$$W \times \%\ \text{grade} - W \times \text{rolling resistance} - 0.003\ V^2 A. \quad (1)$$

Assuming a constant of 40 lb. per ton of rolling resistance and a frontal area of 25 sq. ft. the energy of a 3000-lb. car which must be absorbed while maintaining constant speed down grade is shown for constant per cent grade

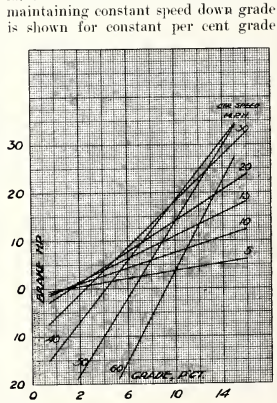


Figure 2. Power absorbed by brakes in maintaining constant speed down grade on varying grade.

in Figure 1, and for constant car velocity in Figure 2.

These values of b.h.p. can be converted into B.t.u. per hour in the study of problems of heat dissipation of brakes, and are for net braking at the

assumed conditions. When used for varying speeds a correction for the rotational energy in the revolving parts should be made.

Wheel-Weight Transference

One of the results of acceleration or deceleration is to change the relative weight on the front and rear wheels. There will be an increase of rear-wheel weight when accelerating that is noticeable in rear-spring deflection. This gives the car the appearance of coming down on its haunches when vigorously accelerated. The action during deceleration results in an increase of front-wheel weight, which can be computed as follows:

Let W = total weight of vehicle in lb.
W_f = weight on front wheels in lb.
W_r = weight on rear wheels in lb.
l = length of wheel-base in inches.
h = height of center of gravity from road in inches.
f = force of retardation or acceleration in lb.
m = mass of car.
g = 32.16 ft. per sec. per sec.
a = acceleration or retardation in ft. per sec. per sec.

Then, $f = ma = \frac{Wa}{32.16}$.

This force acts to overturn the car about the front wheels, with a turning moment equal to

$$f \times h = \frac{Wha}{32.16}. \text{ (in lb. in.)}$$

The resultant turning moment during braking effects a decrease of rear-wheel load and an increase of front-wheel load, as follows:

$$\text{Transference of load (lb.)} = \frac{Wha}{32.16 \times l}. \quad (2)$$

$$\text{Then, } W'_f = W_f + \frac{Wha}{32.16 \times l},$$

$$W'_r = W_r - \frac{Wha}{32.16 \times l},$$

and for change of weights during deceleration,

$$W_f - W'_f = \frac{Wha}{32.16 \times l}, \quad (3)$$

$$W_r - W'_r = \frac{Wha}{32.16 \times l}. \quad (4)$$

For each 1000 lb. of car weight and with values of h/l of 0.15, 0.20, 0.25, and 0.30, the increase of front-wheel load or decrease of rear-wheel load is shown in Table I and Figure 3.

Assuming a 3000-lb. car with a static weight distribution of 40 per cent on the front wheels and 60 per cent on the rear wheels, and the general condition of h/l = 0.20, corresponding to a 120-inch wheel-base and 24-inch distance from the center of gravity to the

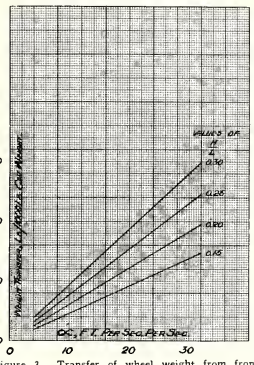


Figure 3. Transfer of wheel weight from front to rear or rear to front, due respectively to acceleration or deceleration. H represents the height in inches of the center of gravity above the road, and L the length in inches of the wheel-base.

road, the decrease in rear-wheel load is something under 200 lbs. when subject to the maximum practical retardation with rear-wheel brakes. The loss in the lineal force of retardation in pounds is (200 × 10) 32.16 or 62 lb. from a maximum of (3000 × 0.60 × 10) 32.16, or 560 lb. With lesser retardation as required on slippery roads, the rear-wheel weight decrease, will be proportionally less.

In the case of four-wheel brakes the decrease of rear-wheel load, which is added to the front wheels, makes it theoretically possible to realize the full weight of the car in braking. Considerations of steering and brake equilization with their effect on skidding appear to make 20 ft. per sec. per sec. practically the limit of deceleration with four-wheel brakes. Four-wheel brakes, by doubling the possible deceleration, are especially valuable in emergencies. Braking above 8 or 10 ft. per sec. per sec. is uncomfortable, but is less so in automobiles than in railway cars, since the occupants of the former usually have a view of traffic conditions and are prepared for the sudden retardation. At 10 or 11 ft. per sec. per sec. the forward thrust amounts to about one-third the passenger weight, and with severe application of four-wheel brakes the retardation may result in forward forces acting on the passenger, equal to his weight. (a = 32.16.)

In dealing with retardations close to the point of slippage of the braked wheels and the road, attention must be given to the character of the road surface. In the case of rough roads, vertical inertia forces may decrease the wheel load on the road as low as zero when the wheel leaves the road. Intermediate wheel loads during rough going give lower maximum values of retardation and may greatly affect stopping distances. Stones or gravel on the road surface may act as ball bearings and greatly decrease the available braking force.

Stopping Distances

The distance required to stop a vehicle on a level road is determined by the braking resistance, the rolling resistance, and the wind resistance. These factors absorb the translational energy and the energy of the rotating parts of the vehicle. Assuming:

TABLE I

Decrease of Rear-Wheel Load or Increase of Front-Wheel Load, in Pounds per 1000 Pounds of Car Weight

Values "a"	h/l 0.15	h/l 0.20	h/l 0.25	h/l 0.30
2	9.3	12.5	15.6	18.7
4	18.7	24.9	31.1	37.4
6	28.0	37.3	46.7	56.0
8	37.3	49.8	62.2	74.6
10	46.7	62.2	77.8	93.3
15	70.0	93.3	116.7	140.0
20	93.3	124.5	155.5	187.0
25	116.7	155.6	194.3	233.4
30	140.0	186.7	233.3	280.0

S = stopping distance in feet.
W = total weight of car in lb.
W^r = weight on rear wheels in lb.
W_f = weight on front wheels in lb.
M = mass of car.
E = kinetic energy.

V = velocity of car in m.p.hr.
v = velocity of car in ft. per sec.
C = "coefficient of friction" of tires to road.
a = acceleration in ft. per sec. per sec. (positive or negative).
f = retarding force in lb.

Then the kinetic energy of the moving vehicle will be.

$$E = \frac{Mv^2}{2} = \frac{W}{2g}\left(V \times \frac{5280}{3600}\right)$$

$= 0.0335V^2$ in ft. lb. per lb. of car weight. (5)

When $C = 0.65$ the maximum retarding force for rear-wheel brakes is

$f = 0.65W_r$

and, $E_{max} = 0.65W_r \times S$, in ft. lb. per total car weight,

or, $E_{max}\frac{W_t}{W} \times 0.65S$, in ft. lb. per lb. of car weight. (6)

Combining equation (5) and (6) and simplifying,

$$S = 0.0335V^2 \times \frac{W}{W_r} \times \frac{1}{0.65},$$

or, $S = 0.0335V^2 \times$ (a constant).

Since the constant $= \frac{32.16}{a}$,

$$S = \frac{1.076V^2}{a}. \qquad (7)$$

The minimum stopping distance with adequate brakes is, therefore, a

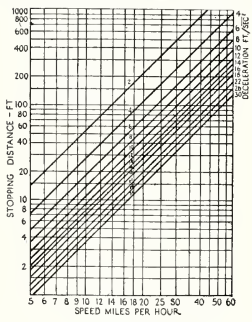


Figure 5. Relation between stopping distance, rate of deceleration, and speed at which vehicle is traveling. (Courtesy, Automotive Industries.)

function of car velocity and deceleration. Heavy cars may be stopped as quickly as light cars. The deceleration, however, is a function of the weight on the braking wheels and maximum tire adhesion.

Formula (7) does not include (a) rolling resistance of the car, (b) wind resistance, or, (c) deceleration of the rotating parts of the vehicle. Items (a) and (b) decrease, and item (c) increases the stopping distance. These factors influence the problem in the following manner.

Rolling Resistance

Rolling resistance on hard roads has a fair value of $(W/1000) \times 20$, in lb., and, since $f = W/g$, the rolling resistance will produce a retardation of

$$a = \frac{g}{W} \times \frac{W}{1000} \times 20,$$

or about 0.60 ft. per sec. per sec. It is possible that this value is increased

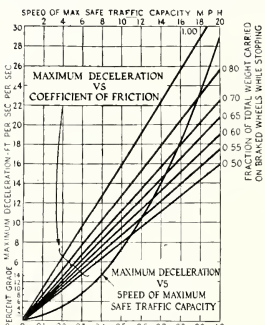


Figure 4. Relation between maximum deceleration, coefficient of friction, fraction of total weight on braked wheels, and speed of maximum safe traffic capacity. (Courtesy, Automotive Industries.)
Figure 8. Deceleration rate and stopping distances from various initial speeds.

during severe braking by the additional flexure of the tires. The assumed factor is a function of the character of the road, and in the case of sand or snow may reach many times the value given. In the case of a free-rolling car and favorable road and tire conditions the rolling resistance may be as low as half the value assumed. The effect on stopping distances will be to increase the value of 'a' in Equation (7).

The determination of the value of 'a' pertaining to rolling resistance may be conveniently made by means of an accelerometer, and when so obtained will include wind resistance, which is negligible below 10 m.p.hr.

Wind Resistance

Wind resistance has a fair value of $0.003V^2A$, in lb., and produces a retardation of 'a' $= (g/W) \times 0.003V^2A$; or 'a' $= 2.4V^2/W$ for cars of 25 sq. ft. frontal area. (See Table II.) It will be noted that in Table II the retardation due to wind resistance is given per 1000 lb. of car weight, and is inversely proportional to the weight. It has little practical value in traffic problems.

Table II
Effect of Wind Resistance per 1000 lb. of Car Weight
(A = 25 Sq. Ft.)

M.p.hr.	a
5	0.006
10	0.024
20	0.960
30	2.160
40	3.840
50	6.000
60	8.640

Deceleration of Revolving Parts of a Car

The total flywheel energy of revolving parts of a car is

$$E = \frac{1}{2} M a^2 k^2$$

or, $E = \frac{W}{2g} V^2 k^2$

where k is the ratio of wheel radius to the radius of gyration. Since most of this energy is in the wheels (engine braking not used) we may assume $k = 0.75$, the wheel radius being about 1.2 ft. Changing to the miles per hour basis, we have

$$E = 0.0188V^2 \qquad (9)$$

in ft. lb. per lb. of rotating weight referred to wheels. Since the road

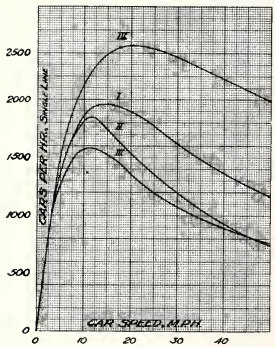


Figure 6. Relation between car speed and number of vehicles per hour, in single file, which can pass a given point. Curve II (by J. S. Swan) assumes a spacing equal to the stopping distance, a car length of 15 ft., and an equal deceleration of 8 ft. per sec. per sec. Curves I, III, and IV (by Professor Roesch) are the result of attacking the problem from a new angle. Note that the results of Curve IV agree with what is commonly considered as the car speed at maximum highway capacity.

wheel weight is about 7 per cent of the car weight, the net effect will be to

(Continued on page 112)

PORTLAND CEMENT CONCRETE

By

W. E. HART

Manager Structural Bureau, Portland Cement Association

WHILE the extensive use of portland cement is a comparatively modern development we are this year commemorating the one hundredth anniversary of its manufacture. Few attempts were made to produce portland cement in the United States until about 1870 and engineers were quick to show a preference for this new material. The general acceptance of reinforced concrete, about 1900, as a type of construction of practically unlimited possibilities, enormously expanded the use of cement. The subsequent history of the portland cement industry in the United States has of course paralleled the universal adoption of concrete as a construction material, exemplified in private and public works on every hand.

It is interesting to reflect upon this period of development and to note the methods of manipulation of the material, destined to become the primary construction medium of the present era. The general practice in the manufacture of concrete during the period prior to 1900 seems to bear out the fact that as far as quality is concerned, engineers were specifying and obtaining a very good product. Quality specifications were rigid indeed, and many of the better principles then employed were later sacrificed on the altar of quantity production. Cleanliness of aggregates was early recognized as a highly necessary factor in good concrete construction. Note, for instance, the requirements for clean sand, as specified by Mr. Walter Katte, C. E., in 1895: the sand should be absolutely clean, so that it "will not soil white paper when rubbed upon it." The washing and grading of both the fine and coarse aggregates and proportioning of the cement and water content so as to produce a uniform product were emphasized in early specifications. It was during this time that the "Interstitial Space" theory of proportioning was being advanced.

Exhaustive experiments were made by Mr. C. H. Platt, C. E., in the proportioning of aggregates and cement on the per cent voids basis. Using a "sea-washed silica gravel" he determined the percentage of voids by water displacement. Enough cement mortar (1 part portland cement to 2 parts washed sand) was then mixed with the gravel to fill the voids thus determined. "Tests of specimens composed of 1 part cement, 2 parts smallest size silica (sand) and 6½ parts largest size (½ to 2-inch), molded into 6-inch cubes showed a crushing strength of 2,500 lb. per sq. in."

Mr. W. E. Hart.

Machine mixing had as yet not been widely introduced and was used only on some of the larger works. Rules for mixing, therefore, covered hand methods. It may be well to note that general practice provided that a mixture be as dry as possible, the sand and cement being first mixed dry, sufficient water added to form a plastic mortar, thus: "with only enough water added so that a handful sticks well together." This mortar was then spread evenly over the layer of stone which had been previously spread on a tight platform, the entire mass being turned "with shovels three or four times, keeping an even thickness, and each stone will be coated with a homogeneous film."

Excess mixing water was generally condemned and the necessity of ramming the concrete into place in thin layers was conceded to give a better product than if the mixture was "deluged with water." Concrete was placed in such consistency that "when placed and rammed the water which comes to the top will be small in quantity, and will not carry out cement."

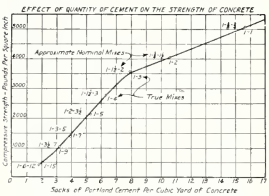
Standard specifications for canal work in New York State as revised in 1901 may be accepted as an index to practice of the highest grade, prevalent at that time. It must be remembered that the manufacture of cement had not reached the high standards of quality and uniformity required by present-day specifications. Therefore, the old New York State requirements were that "the cement must not be used directly from any original package, but the contents of five packages must be first mixed dry in order to secure uniformity." Regarding the fine aggregate, "the specified proportions of dry sand shall also be measured by bulk in the mortar box where the dry cement shall be uniformly spread over it." Screening of the cement and sand mixture was optional at the direction of the engineer if he deemed it advisable in securing a "perfect mixture." A uniform color and absence of streaks had to be attained before water was added, which was required to be done in such a way as to avoid washing the cement from the sand.

Before beginning construction the engineer in local charge had to determine the voids in the crushed stone or gravel which was to form the aggregate, by the water displacement method. The amount of mortar was then based upon the amount of voids thus determined, an allowance for excess amount of mortar above the "natural voids" was limited to less than one or two per cent of the total mass of the loose aggregate. The proportions thus obtained were used until a change in the character of the aggregate required a slight variation in the mortar. Samples of sand were required to be first submitted to the state testing laboratory. If an injurious amount of loam, silt, or friable or soluble material was found the contractor was obliged to wash the material before it was brought on the work.

The clause on coarse aggregate required that: "Crushed stone for concrete shall be of approved kind and quality of rock which must be known, before crushing, to be free from soil, or mud, or dirt." As to grading: "The

crusher shall be set to produce fragments whose maximum dimensions shall be 2½ inches and shall include the smaller product of the crusher except the dust which shall be removed by a screen. In special cases where the State Engineer may consider it to be of advantage to the work to use the total product of the crusher, the actual amount of crusher dust per cubic yard of crushed stone shall be determined and this shall be considered as a substitute for an equal bulk of sand."

Machine mixing was required where the quantity of concrete in any one location exceeded 200 cubic yards.



Showing the increase in compressive strength of concrete with increase in quantity of Portland cement used.

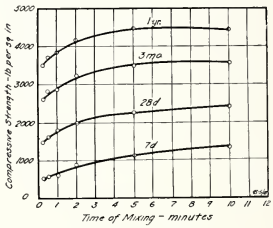
"The machines must be of an approved type and regulate the proportions of the concrete mixture mechanically; continuous mixers in which the proportions depend upon shovellers will not be allowed on the work."

Placing was specified to be done in layers not to exceed 9 inches, each layer being thoroughly rammed: "In joining new concrete to old work or to concrete that has already set, precaution shall be taken to secure a perfect bonding by cleaning and washing the work already in place, and by spreading over its surface a thin layer of mortar before the new concrete is placed." On the method of transporting concrete to the forms, this provision was made: "No concrete shall be slid down a chute or thrown to the place where it is to be laid, but it shall be carried and deposited without dropping or rolling." Necessity for continuous placing was also recognized: "In any given layer the separate batches must follow along so closely that each is placed and rammed before the one just preceding has set." Compacting was severely emphasized. The ramming was required to be conducted so as to form "a compact, dense, impervious, artificial stone, whose specific gravity is close to that of the natural rock which was crushed to form the aggregate. The ramming must be so thorough as to compact the concrete perfectly and to fill the voids so that the water comes to the surface and the mass quakes slightly under the blows of the rammer and shows a smooth face when the forms are removed."

The importance of curing and protection against the elements were well understood. All finished and unfinished work had to be kept moist by sprinkling at short intervals. In warm weather the concrete had to be covered with canvas or otherwise protected from the sun, and in cold weather it was required to be kept covered in such a way as to prevent freezing. Special care was to be required in mixing mortar with the least amount of water "which will give complete combination."

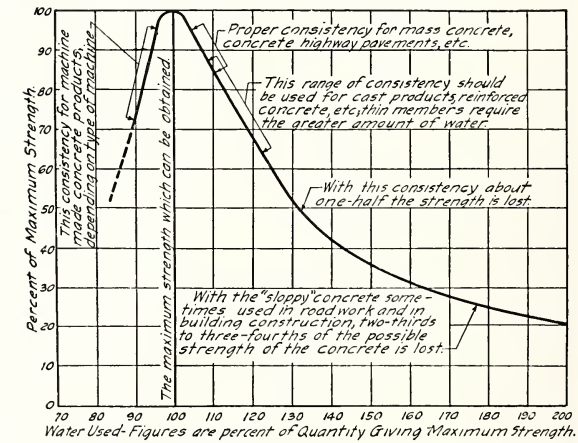
Though the foregoing excerpts of old specifications may seem ridiculous to some, and to others as being too severe to be economical under present-day conditions, yet it must be conceded the constructors of the past generation were familiar enough with fundamental requirements for making good concrete to establish a high quality standard for the product.

In the light of this new record of previous practice it is seen that as far as the improvement of quality in the manufacture of concrete is concerned, we have progressed little. Portland cement, on the other hand has been advanced in quality by a uniform process of manufacture, conforming to rigid requirements of national specification standards. Today cement remains the only constant factor entering into the manufacture of concrete. Quality of cement has not been sacrificed for quantity production, rather quality and uniformity have measured the growth of this gigantic industry. When the quality of concrete manufacture has approached the present standard set-up in the manufacture of portland cement, it will be time to seek for further improvements in the latter, but there is no present economical reason or demand that would warrant increasing the requirements and costs of the manufacture of the cement when the manufacture of the concrete is disregarded or often utterly neglected.



Relation between time of mixing and the compressive strength of concrete.

The apparent lack of proper consideration given to, and the continued abuse of known principles and methods of constructing with so universal a material as concrete, is nothing short of professional negligence.



Effect of quantity of mixing water on the compressive strength of concrete. Note: In general construction, the maximum strength can rarely be obtained, but it is possible to obtain 70 to 90 per cent of the maximum strength without additional expense by restricting the quantity of mixing water.

The shameful condition of laxity prevailing quite generally in our application of concrete to modern adapta-

(Continued on page 110)

A HISTORY OF ARCHITECTURE IN ILLINOIS

By

THOMAS E. TALLMADGE

Chairman of the Historical Committee, American Institute of Architects

ILLINOIS, chronologically at least, can lay claim to all of the styles of modes into which American architecture is usually divided. The very few buildings remaining to us, built prior to 1818, the year in which Illinois was admitted to the Union, would chronologically belong to the Colonial or more properly the Georgian style. They are contemporary with the beautiful Colonial houses and churches of New England, and the stately manors of Virginia and Maryland. Built, however, almost entirely by French frontiersmen, ignorant and poverty stricken, of the rudest materials, and with little attempt at decoration, they bear little similarity to the buildings of the same period in the thirteen colonies. Kaskaskia, Cahokia, which contains a church built in 1765, and Prairie du Rocher, with Fort Chartres, whose powder house is the oldest building in Illinois, furnish us our only examples.

From about 1800 to 1850, it was the mode in Europe to build in the classic style of Rome, and more particularly of Greece. Thomas Jefferson introduced this stately, if somewhat pompous and artificial style into America, and it soon supplanted in the east the graceful Georgian-Colonial. Do not think that our best people in the raw upstart villages in the prairies of Illinois would be content to be behind the times when a new house or church or a courthouse was to be built, and we soon find the Classic Revival or the Greek Revival, as it is often called, in full bloom throughout the state. In Chicago almost all examples of this style were destroyed by the great fire of '71, but in every town dating prior to 1850, we can find many examples. Columns, a characteristic style in the east, were not often used, but pilasters, door and window trim, and the cornice mouldings, are unmistakably Greek.

About 1850 the extraordinary breed, half carpenter, half architect, that could take a European style and translate it with intelligence and good taste into the American vernacular, seems suddenly to have perished, and we find ourselves, Illinois, as well as the whole country, plunged without warning into an era of the most atrocious architecture and meretricious taste that has ever blighted a land. This seems to have been an attempt to copy simultaneously several European styles of which the principal were the Victorian Gothic of England, and the Parisian Renaissance of the time.

We usually, for the want of better name, call this the war-time period, and

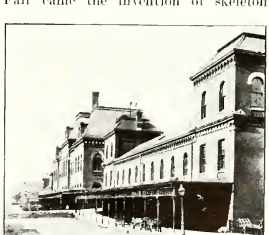
The Tacoma Building—first of Chicago's skyscrapers.

it lasted until 1880. It is the period of hoop-skirts, and wax flowers, and top-heavy walnut bedsteads, and Dundreary whiskers. In architecture, its technical failures were partly owing to a singular lack of adequate copies in drawings or photographs of the European examples which we were trying to imitate. Chicago has many examples of this war-time style, as it was all the vogue when the city was rebuilt after the fire. Our old City Hall, the Palmer House, and the Union Station are typical examples. The detail on the old City Hall was, for the most part, copied from the Paris Opera House. The most eloquent example outside of Chicago is the State House in Springfield.

About 1880 the extraordinary personality of Henry Hobson Richardson blazed forth in Boston in his masterful design of Trinity Church. This epoch-making church was built in a free adaption of the French Romanesque. The Romanesque now became the rage. In Illinois we find a few good and many bad attempts to make the heavy round arches and barbaric ornament of the eleventh century to duty in the nineteenth. With all its faults it was a great improvement over the atrocities of the preceding period, and some of the best examples we can see right before us in Chicago. The Marshall Field wholesale, the Glessner, and McVeagh houses from the hand of the great Richardson himself; the Chicago Club, and Rookery Building by Burnham & Root; the Auditorium by Adler & Sullivan, and many others.

In 1893 the people and the architects were swept off their feet by the dazzling beauty, and the overpowering majesty of the Roman colonnades and Renaissance domes of the World's Fair. We usually refer to the World's Fair as the rebirth of good taste (if we can call good taste our present eclecticism and dependence on European styles, present and past). At any rate, it gave the coup-de-grace to the Romanesque Revival or the Romantic Style as it is sometimes called, already moribund from the onslaughts of the rapidly increasing number of Beaux Arts men. With all its faults the Revival, going back to first principles as it did, gave promise of a brilliant future. Who knows but what it might have developed into that thing which we have almost despaired of: an "American Style"?

Only shortly preceding the World's Fair came the invention of skeleton



The Union Station. A survival of the war-time period of architecture.

steel construction, and the passenger elevator. These together gave birth to the skyscraper—the first complete ex-

Do you remember way back when—The old County Building stood on the site of the present City Hall? It was a replica of the Paris Opera House in exterior detail.

ample of which is the Tacoma Building, by Holabird & Roche. The architect has, unfortunately, used no new forms to glorify this magnificent achievement of the engineer, and the acanthus leaves of Greece, and the modillions of ancient Rome, are still doing duty three hundred feet in the air, possibly gazing up and down in wonderment of the aeroplane and the automobile, and other evidences of man's progression and independence outside the realms of art. The period, then, in which we are now, dates from the World's Fair, and will probably be known as the "Eclectic" period. Its characteristics are high technical skill and taste among the architects and their clients. The Ecole des Beaux Arts and our own Architectural Schools have produced architects with sufficient knowledge and skill to design in any fashion. Extended travel and dissemination of illustrated journals on art and architecture have opened the storehouse of the past, and the layman, who has only to help himself to any treasure that he may fancy.

The styles most in favor are the modern and renaissance styles of France, Italy and England, though under the leadership of Cram & Goodhue there has been a strong revival of Gothic for ecclesiastical and educational purposes. The University Club, the Monroe Building, and the Peoples Gas, all erected at one time and in different style, show the eclectic tendency.

We should be proud of the fact that the only conscious attempt to break away from European precedent and to create a new style which would be distinctly American occurred in Chicago. The leader of this revolt, the prophet and the apostle of the new dispensation, was Louis H. Sullivan. The movement had glorious birth in his fight, sacrificing often popularity for principle.

The characteristics of the style are the strict avoidance of European precedent, an unusual emphasis on the horizontal line, a frank acknowledgment of the construction, and materials and the use of indigenous natural forms in the ornament. The style, sometimes called the Chicago School, has been unfortunately discredited by the excesses of some of its practitioners and has often been made ridiculous by the atrocities perpetrated by ignorant contractor-architects, who have travestied some of its forms and motives in cheap flats and stores. Its best expression we see today in the small houses whose owners have not been educated up to the "styles" and in the warehouses and commercial buildings where the logic of its forms makes a happy union with modern engineering. Peculiarly adapted to the clothing of the skeleton of the skyscraper, there are unfortunately only two examples of such use in Chicago and both have been preeminently successful, the Garrick

The Marshall Field Warehouse, by Richardson, embodies the best of the Romanesque period.

Transportation Building of the World's Fair. It has been fostered by a small number of brilliant and courageous men, who in the face of opposition and indifference have carried on a losing

Theatre Building and the Gage Building, both by Mr. Sullivan.

The familiar and commonplace building of today is the historic monu-

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THE PATENT PRIVILEGE IN THE UNITED STATES

By
CHARLES W. HILLS, Jr., '11
of the firm of Charles W. Hills

HISTORICALLY the patent system of England had its origin in royal grants by which monopolies in trade and manufacture were bestowed on a few favored subjects of the crown.

While originally the grant seems to have been made as a reward for some benefit conferred upon the state or to stimulate mercantile enterprise and trade, this was at last so departed from as to permit the monopoly to be the subject of purchase or of grant to a royal favorite. Competition was by this means destroyed and the favored one, having practically unlimited power to control prices of necessities, used his privilege to the great injury of the people. This evil practice found its greatest friend in Elizabeth with whose remarkable grants to favorites history has made all familiar.

Hume, in his history of England, cites forty different commodities in common use, which were monopolized in trade by grant of the queen. These royally favored monopolists were exorbitant in their demands. For example, the salt monopolists raised the price of salt from sixteen pence to fourteen shillings a bushel; while those who held patents granting a royal monopoly on salt-petre exercised their power to enter any building and dig for their ware, exhorting money from those who desired to be free from such trouble.

It was not until 1624, during the reign of James, that the famous Statute of Monopolies was passed. This statute abolished all royal monopolies and denied the right of the crown to create them in the future but expressly excepted grants for limited times to inventors of manufactures new within the realm. This exception is significant and clearly indicates that it was the purpose of the framers of the statute not only to destroy all monopolies of the class described—injurious to trade and commerce—but as well, to reward one, who, by his own industry had introduced to the realm a new manufacture. The reward was limited to the grant of the exclusive right to manufacture and sell the invention for a limited time.

Such grants had been made long before the passage of the Statute of Monopolies and had been found to operate as an incentive to the increase of trade and manufacture, and therefore were of great value to the realm. Even in those early days one who by his own original invention brought to the realm a new manufacture was considered a public benefactor and his grant was looked upon as a deserved reward.

Mr. C. W. Hills, Jr.

As early as 1558 an Englishman and an Italian jointly presented their petition for the grant of an exclusive patent for introducing a new art into England. The application was granted in 1562. At first, in England, inventions were considered to mean importation as well as discovery.

Systematic grants of patents for inventions in England date from the so called "Statute of Monopolies" and it is significant that England, then a country in the pastoral state, whose chief export was raw wool, soon became noted for her manufactures; finally outstripping all rivals in industrial progress and especially in those intelligent phases of it which lead most rapidly to material wealth.

While thus encouraging trade and manufacture in England by grants of patents to inventors, every effort was made to discourage manufacture in the colonies by severe restrictive laws. Even Pitt, the friend of the colonies, in a speech made in Parliament in 1766, denied to the colonists the "right to manufacture as much as a horse shoe nail." True, the colonies had in several instances made grants to inventors, but such grants were disapproved in England.

It should be kept distinctly in mind that at Common Law the inventor had absolutely no property right to his invention when divulged, and, if he hoped to exercise exclusive control over the same, or desired to obtain the exclusive benefit thereof, it was necessary that he should either not practice the invention at all or that he should practice the same secretly and necessarily in a small way, sedulously keeping it from the knowledge of his fellow men. His invention once seen and understood by another, became common property, and he who would, might make use of, or vend it at his pleasure, thereby enjoying an advantage equal to that enjoyed by him from whose mind the invention sprang. As a consequence (and a careful reading of history makes this evident) the world received permanent profit and benefit from comparatively few of the many inventions devised before their recognition as property rights. Why? Simply for the reason, that the inventor if he hoped to derive profits from his invention, was forced to practice the invention in secret, and the secret frequently died with him. Do not the pages of history bear testimony of this? Have not glass blowers, since the time of the Roman Empire, striven to rediscover the process of making glass flexible or to rediscover certain processes for coloring glass, evidently known to someone in the past, as evidenced by the fragments of glass vases in our museums. Have not tool makers long sought to rediscover the process for tempering steel known to the armorers of Damascus, which made the Damascus blade famous in the past, and the few examples which still exist marvels of interest to skilled metal workers? We need not continue the list. Many other examples, particularly of lost processes, will occur to the mind of the reader. Lost, through the self-interest of the inventor who instinctively felt that the creation of his brain was his, and that he was entitled to reap what profit he might by the secret exercise of his art. True, there were many noble exceptions. It is probable that we owe much if not most of the great mechanical inventions to the fact that the bulk of the article did not permit of secrecy, and to that love of the work

and that desire for the fame to be derived from achievement, that has impelled men to spend their lives in the pursuit of discovery in mathematics, astronomy, geology, or in the nobler purpose to benefit humanity that actuated such men as Livingston, Von Humboldt, and Agassiz. Men of this class, however, in any age are but few. The great body of workmen in the past were not only content to continue to work following the old lines, with their eyes closed to new discovery, but further impelled by this vicious and mistaken idea, they destroyed the new machines and mobbed their inventors.

These were the conditions existing in our country at the time of the adoption of the Constitution and it was perhaps natural that one of the most popular clauses in the Constitution was the provision that "Congress shall have power to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

By recognizing the property right in inventions and discoveries for the limited times granted in the patent, the United States—first of all nations—attempted the experiment of developing science and the useful arts within its domains, by granting to inventors and discoverers, not as an act of grace, not as a gift, but by way of recompense and upon a contractual basis for the term of years (originally fourteen, now seventeen) from and after the date of the patent, the exclusive right to make use of and vend the invention throughout the United States and its territories.

This special clause of the constitution has been ascribed to Hamilton or to Washington, and it is certainly probable that it was strongly favored by both, inasmuch as Washington in his first message said:

> "The advancement of manufacture and agriculture by all proper means will not, I trust, need recommendation, but I cannot forebear intimating to you the expediency of giving effectual encouragement to the introduction of new and useful inventions abroad as well as to the skill and genius producing them at home, and of facilitating the intercourse between different parts of our country by due attention to the Post Offices and Post Roads. Nor am I less persuaded that you will agree with me in the opinion that *there is nothing which can better deserve your patronage than the promotion of science and literature.*"

This was deemed of sufficient importance for Congress to act almost immediately upon the suggestion and on April 10, 1790, a law was passed, providing, that any person who had invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, might obtain a patent therefore. The terms and conditions under which such grant was to be obtained were also fixed by this act. Some of the most important of these terms and conditions still find expression in Section 4888 Rev. Stat. U. S. which reads as follows:

> "Before any inventor or discoverer shall receive a patent for his invention of discovery, he shall (1) make application therefore, (2) in writing, to the Commissioner of Patents, (3) he shall file at the Patent Office a written description of the same and of the manner and process of making, constructing, compounding and using it, (4) in such full, clear, concise and exact terms, as (5) to enable any person or persons skilled in the art or science to which it appertains, or to which it is most nearly connected, to make, construct, compound, and use the same: and (6) in case of a machine he shall explain the principles thereof and the mode in which he has contemplated applying that principle so (7) as to distinguish it from other inventions, and (8) (since added) he shall distinctly point out and claim the part, improvement or combination which he claims as his invention or discovery."

A United States patent has been said to be a contract. On the contract theory the parties to the contract are the inventor on one hand and the people of the United States on the other. The inventor, by public records (his specification, claims, and drawings) informs the people concerning the useful discovery he has made, which must be original with him and new in the United States. In return, the people by their governmental grant of Letters Patent, secure to him the exclusive right to make, to use, and to sell his invention for a limited number of years, at the end of which period the contract terminates and the discovery belongs to the public forever thereafter.

This view of a United States patent has been held by every Chief Justice of the United States, since and including the great John Marshall, who in the leading case of Grant *vs.* Raymond, 6 Peters 218, said:

> "It cannot be doubted that the settled purpose of the United States has ever been and continues to be to confer on the authors of useful inventions an exclusive right to their inventions for the time mentioned in the patent. It is the reward stipulated for the advantages derived by the public from the exertions of the individual and is intended as a stimulus to those exertions. The laws which are passed to give effect to this purpose are, we think, to be construed in the spirit in which they have been made, and to execute the contract fairly on the part of the United States where the full benefit has been actually received, if this can be done without transcending the intentions of the statute or countenancing acts which are fraudulent and may prove mischievous. The public yields nothing which it has not agreed to yield—it receives all which it has contracted to receive. The full benefits of the discovery after its enjoyment by the discoverer for fourteen years (now seventeen years) is preserved, and for this exclusive enjoyment of it during that time, the public faith is pledged."

Courts have, with practical uniformity, sustained the proposition that a patent is the evidence of a contract, and that the great object and intention of the act is to secure to the public the great advantages to be derived from the discovery of the individuals and to stimulate to further discoveries. The means it employs are the compensation made to these individuals for the time and labor devoted to these discoveries, by the exclusive right to make, use, and sell the things discovered for a limited time.

A patent, therefore, does not flow from the bounty of the community as might be said of a pension, a subsidy, or a medal. It belongs to the inventor by right. It comes into existence in consequence of a full disclosure of a certain state of facts, namely, that the invention is new, useful, and original with the claimant. This disclosure is the consideration on the part of the inventor, and confers upon the community something of value which it did not before possess. The community gives to the inventor, not something of value which it already has, as where a part of the public domain is granted to a settler, but simply protection for a limited time. If his invention is valuable, so is the protection. If the invention is worthless, the protection is without benefit. Thus the contract is reciprocal, and is equally balanced. The validity of the patent depends upon the maintenance of the facts established. The determination of validity is apportioned to the United States Courts. To determine whether the consideration probably exists, and to make the contract itself, is a function of the United States Patent Office,

(Continued on page 114)

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

About a year ago we announced on this page the organization of the Detroit Branch of the Armour Alumni Association. This is a movement in which all Armour men are interested, and one which we hope to see carried out in many other cities as our membership increases.

At the time of our original announcement we were able to tell our readers very little about how this branch came to be started, or of the considerations which induced the organizers to start the movement.

Harold S. Ellington, '08, was one of the moving spirits and it is due very largely to his efforts that we have a branch at Detroit. We are pleased to present below an article by Mr. Ellington, which tells the story of the founding of first local branch of Armour Alumni Association.

DETROIT BRANCH ALUMNI ASSOCIATION OF ARMOUR INSTITUTE OF TECHNOLOGY

By Harold S. Ellington, '08

For several years there has been in Detroit an organization known as the Intercollegiate Association which is composed of the Alumni Associations of practically all of the colleges and universities in this country.

Each year this Association has held two or three very important and pleasant meetings, with an attendance of 1000 to 1200 college men. The annual baseball party and football smoker of the Intercollegiate Association are probably two of the most inspiring events which take place among the college men in this city. Old friendships are renewed, new ones are made, and the spirit which prevails among these university and college men cannot help but bring fond recollections to all who attend these meetings.

Having had the privilege of attending these affairs, and realizing that the alumni of Armour Institute of Technology had no official membership in the Association, I felt it somewhat of a duty to make it possible for Armour alumni in Detroit and vicinity to participate in these affairs, and at the same time perfect a branch Alumni Association which could be of some general usefulness to its members and the Institute. I knew several Armour men in Detroit through business and social acquaintance and suggested the idea of forming a permanent organization in this city. They willingly subscribed their support and early in 1922, after considerable effort in obtaining the names and addresses of Armour men through various sources, a general letter was sent to all of them outlining our ideas and soliciting their co-operation; also the names and addresses of any Armour men with whom they might be acquainted.

Several months passed before it was possible to obtain a list of sufficient proportions to justify the effort in forming a Detroit branch. However, it gives me great pleasure to say that the effort which was made has been fully repaid in the meetings which have been held.

The first Armour alumni luncheon was held Thursday, October 19, 1922, at which meeting there were present eight men of the twenty-four to whom invitations had been sent to attend this meeting. The affair was entirely informal and we discussed the advisability of organizing a Detroit Alumni Branch, and it was the unanimous opinion of those present that such an organization should be perfected. The following men attended the first meeting:

W. G. Hoy, '05
Roy G. Grant, '08
H. S. Ellington, '08
H. G. Todtmann, '12
Claud Lundblad, '13
Harold D. Gumpper, '14
Richard N. Mann, '18
Royall Chappell, '18

Inasmuch as it required ten Charter members to obtain a Charter from the Alumni Association of Armour Institute of Technology, the meeting adjourned to November 2, 1922, on which day a permanent organization was perfected. The following officers were elected:

President.....Harold S. Ellington, '08
Vice-President.....W. G. Hoy, '05
Secretary-Treasurer. Conrad L. Ott, '16

A committee was appointed to draft the constitution and by-laws. The Alumni Association of Armour Institute of Technology was petitioned for a Charter for the Detroit Branch and the following men constituted the Charter members:

W. G. Hoy
Albert N. Koch
Roy G. Grant
Richard N. Mann
H. G. Todtmann
Claus D. Lundblad
Arthur J. Allyn
L. H. Badger
Howard B. Maguire
Harold S. Ellington
Conrad L. Ott
Carl H. Lundblad
Ira J. Turnbull

At this meeting it was decided to hold regular meetings the first Thursday of each month at 12:30 P. M. at the Carleton Cafe in the Stroh Building.

At the meeting in December, 1922, the constitution and by-laws were adopted and since this time our monthly meetings have been attended by from eight to fifteen men. What we have lacked in numbers has been made up in spirit and good fellowship. Old friendships have been renewed, new ones made, and in general many good times resulting in mutual benefits, exchange of business and ideas have come from our get-togethers.

In January, 1923, we extended an invitation to the Armour Tech basketball team to be guests of the Detroit Branch when they made their annual trip to Detroit to play the University of Detroit. The Armour team arrived in Detroit on February 10 and several of us met them

(Continued on page 108)

ASSEMBLY AT TEN THIRTY

The portable blackboard just inside the entrance of the main building announces in Doctor Raymond's flowing Spencerian "Assembly at ten-thirty in Mission Assembly Hall. All classes excused and everyone expected to be present." A break in the regular routine is always welcome so the comments of the arriving students are favorable, except from some who have an open hour at ten-thirty. They had planned on that hour for a study period.

At intervals throughout the morning a figure appears at the door of the various offices and classrooms, wherever there is a chance that the occupants may not have seen the blackboard. Well groomed, blue gray eyes, gray hair, youthful countenance; Mr. Kelly, second assistant secretary of state, announcing "Assembly at ten-thirty." After finishing in the main building, he goes across the street to Machinery Hall, up one flight of stairs, and into the office of the Department of Mechanical Engineering.

"Assembly at ten-thirty" impinges on the consciousness of the man at the desk in the inner office. The professor is suffering from a severe cold, and all the world looks blue. Two packages have just been brought to his desk, one by registered mail and the other by special messenger. The first and larger of the two he is just unwrapping, and at sight of the contents his expression becomes more dejected than before; galley-proof from his publisher. He then turns his attention to the second package and the observer at the door notes a marked improvement in his spirits; ninety-proof from his physician.

It is now ten-twenty and students, individually and in groups, are crossing the street towards the assembly hall. On the sidewalk in front of the building a gentleman walks slowly back and forth. Tall, erect, broad shouldered, the physique and the complexion of a viking, the keen eye of a detective, which sees without seeming to look, and the worried expression of Atlas whose responsibilities were no greater. Professor Penn, making a mental note of those who are conspicuous by their absence. He has just decided that a six weeks' course in memory training would have been a better preparation for his present job than four years of civil engineering.

A group of instructors from the shops appears at the door of Machinery Hall. While the others wait, one hurries back for a moment to leave a piece of cotton waste, which, with characteristic professorial absentmindedness, he was carrying in his hand as he left the shop. They cross the street and approach Professor Penn, taking care to pass in front of him.

Inside, the hall is filling rapidly. A large room plainly furnished, flat floor, opera chairs. On three sides a shallow balcony; in front an historic platform. A platform where-on, at intervals for thirty years, have appeared presidents and preachers; poets, pedagogues, poli-

(Continued on page 116)

ADVERTISING AND THE ENGINEERING STUDENT

Being some "straight-dope" about advertising and what the engineering student may learn from it

Do all of us realize that advertising has a value for the reader as well as for the advertiser?

When you stop to think of it, advertising is an institution which has found birth in the evolution of modern society and the modern industrial system. It is as much an essential part of the contemporary industrial and commercial system, as for example, the division of labor. It is so deep-seated in modern economic life that without a revolutionary change in society, we—none of us—could live in our accustomed ways without it. We engineers, depending, as we do to a large extent, upon industry and commerce for our bread and butter, would certainly be "out-of-luck" without large scale production. And the connection between large scale production and advertising is so obvious as to require no discussion here.

But this is a rather indirect and intangible benefit of advertising. Thus far in the evolution of man, we have yet to arrive at that Utopia of intelligence where we pay much attention to possible indirect or future benefits. We reckon benefits in terms of accrued dollars and cents. As engineering students we are principally interested, for the present at least, in benefiting the engineering student. This may be selfish, but some day (we hope) we will have sufficient time and money to permit us to be thoroughly altruistic and philanthropic. How may advertising directly benefit the engineering student?

Before answering this question we ask you to read over the following questionnaire. Follow directions and try to *answer every question.*

"This is a test to determine how familiar you are with certain names and products. Do not sign your name. Write the answer that comes first to mind. A blank means you do not know. Do not return to a question or attempt to correct it after passing on to the next question.

In what branch of engineering do you expect to specialize? When does your class graduate?

Name a leading manufacturer of varnish —— of glue —— rope —— valves —— meters —— industrial chains —— pumping machinery —— cement —— steam boilers —— concrete mixers —— equipment for cutting thick metal —— thermometers —— welding equipment —— asbestos —— air compressors —— automatic sprinklers —— wire glass —— electrical measuring instruments —— ventilating machinery —— industrial bearings —— lubricating oil —— drawing instruments —— bushings —— hair clippers —— storage batteries —— light tractors —— heavy tractors —— tin cans —— elevators —— dynamite —— fire extinguisher —— electric motors —— radio apparatus —— heavy duty motor trucks —— light motor trucks —— taps and dies —— flat factory roofing —— steel window sash —— steam radiators —— anti-slip metal devices —— machine tools.

Name three manufactured products containing zinc —— three with lead —— three with asbestos. Who makes Corliss engines? What material best for house water pipes? Are any ready-mixed paints as good as those mixed by an honest painter with good materials? What material is best for industrial belting—rubber, canvas, or leather? Name one manufacturer of industrial belting. Who makes the Stillson wrench? What advertiser has shown an illustration of an oil pipe line? Who is G. T. M.? What is Toncan? What is Mazda? What is Truscon? What is the most serviceable material for roads on hills? What is the most serviceable material for level roads? Whose recent advertisement was headed "Does Your P. M. Schedule look like this?" What is the leading business or trade paper in your engineering field? Who advertises "specification" roofing? Who markets Gargoyle brand of oils? Who uses the "Dutch Boy" in their advertisements? What is the most economical automobile for salesmen? Which is the best portable typewriter? What business or trade paper do you expect to read after graduation? What magazine do you read regularly? Name one manufacturer of heavy duty oil fuel engines."

Quite a revelation isn't it? The answer to every question is important information upon matters concerning which every engineering student should know. Beside the above, the general run of Mr. Edison's recent flood of questions were dry and devoid of practical value. Does not this prove that advertising has a very definite practical value to the engineer?

Advertising is an economic force used in the distribution of products from industry to industry, and from industry to consumer. An engineering student who does not notice the advertisements in general and business publications is not cultivating the proper attitude of observing the various steps in modern business. The outstanding business men of Europe have for years studied advertising as an index to American business. In the same way, an engineering student who goes through college and ignores industrial history as written in the advertising pages of magazines, is not using his two eyes to best advantage.

To Roy Barnhill, Inc., publishers' representatives of the Engineering College Magazines Associated, we are indebted for the above questionnaire, which was sent out to nineteen of the leading engineering colleges of the country. Two hundred and eighty-five replies were received, all from Juniors and Seniors in these colleges. Some of the results of the replies are very interesting and instructive. (Replies give future professions of the 285 as: M. E., 48; C. E., 110; E. E., 68; Mining, 1; Automotive, 10; Industrial, 10; Chemical, 6; Architecture, 10; Blanks, 14.)

Two hundred and six of the 285 apparently knew no particular manufacturer of thermometers, although probably a large proportion of the thermometers used in laboratory work are of Taylor make—only 46 gave the name of this manufacturer. Two hundred and eighteen apparently knew no manufacturer of welding equipment; 194 no manufacturer of air compressors; 220 no manufacturer of ventilating machinery; 210 no manufacturer of Stillson wrenches. Only 75 answered correctly, "Who markets Gargoyle brand of oils?"

On the other hand, showing that the engineering student is a rather intelligent chap after all, the question, "Whose recent advertisement was headed 'Does your P. M. Schedule look like this?'" was correctly answered in 84 replies, *three months* after its appearance. (See THE ARMOUR ENGINEER, November, 1924.) Also, although a number of glaring failures are given in the preceding paragraph, there were 68 questions in all, and when a complete and thorough study is made, the sum total of the answers received reflect credit rather than discredit upon engineering students. The value of advertising in engineering publications is also demonstrated. The answers to the request to name a manufacturer of elevators were almost unanimously "Otis." And although the three large manufacturers of electrical equipment do not mention any of their products in advertisements appearing in the college publications, 217 non-electricals displayed a creditable knowledge of these products. In fact, the answers received to questions relating to advertisers in technical college publications prove that such advertising really accomplishes its purpose.

To summarize: (1) the engineering student should avail himself of the information obtainable from a study of advertising, and by a study of products *through* advertising—much valuable information may even be obtained through a study of the questionnaire given herein; and (2) advertising in technical college journals *pays.*

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Our Slogan: *Make The Armour Engineer the best technical college publication in the country.*

EDITORIALS

ON WRITING REPORTS

"This report will be due next Monday," so the instructor informs us and we silently make a note in our leather bound books. In our next class we get the same thing and so on down the line. There is no distinction made regarding the type of report, it is merely the same stereotyped report that we have been making ever since we began to write them in our sophomore year. First comes the Title, then the Object, Discussion and Theory, Apparatus, Procedure, and finally the Conclusion. Note: All curves and drawings must be in India ink.

True, the training which we get by writing these reports helps us to get many details which we as students might otherwise miss and it gives us a standard by which to write everything, but is this to be desired? In the field when we are asked for a report, a certain definite item is usually the only part of the entire work which is of interest to our superior. Conclusions and the data upon which they are based are the only items of interest. Time is also a factor which must be considered. Very few busy men care to waste valuable time wading through a long detailed report with a couple of pages of theoretical discussion. What these men desire is the results with the conclusions in a condensed form so that they can understand them.

For example a city engineer wanted a report on a certain type of pump that was being considered for the city waterworks. Specifications were that the conclusions and arguments should not take longer than three minutes to read and that the terms used should be familiar to the city council. This happens to have been the task of one particular consulting engineer but specifications of this nature are not uncommon among our graduates who are in the field.

A problem of this nature would be difficult for any of our men to perform readily, due to the nature of the reports they are accustomed to writing. We believe that far better experience could be gained during the junior and senior years if reports, filling actual practical conditions, were substituted for the present stereotyped form.

—Minnesota Techno-log.

MORE ABOUT THE AWARD OF THE "A"

The editorial in the last edition of The Armour Engineer brought to the front a vital question now facing the Institute. This is the support of college athletics and especially the minor sports that has been undertaken since the activity fee was established. When a student admits that unless he has seen a letter awarded a man at an assembly of the student body, he does not know that that man had represented his college in athletic contests, the controlling spirit, evidently, is not the type that will produce a healthy future for intercollegiate competition at Armour. We are of the opinion that the place to become acquainted with our so-called "campus celebrities" is where and when they are giving their best for their Alma Mater. It is then that knowing them and fighting with them will help our college win.

It is to be regretted that all of our athletes cannot be given their Honor "A" before the assembled student body. We cannot imagine who would want it otherwise if it were possible to make this presentation public. However, the present conditions necessitate sending the sweaters to the men after the semester has ended. This state of affairs is brought about by the fact that most of the teams do not complete their schedules until the last weeks of school. This does not leave sufficient time for the coach to have his recommendations approved by the Board of Athletic Control and have the orders for sweaters filled before the college year has ended.

Let us then, instead of waiting for a final public appearance of our athletes, meet them now and prepare to support them throughout the spring which is the biggest season for sports at A. I. T.

E. E. McLaren. *Pres., A. T. A. A.*

DON'T PITY THE ENGINEER

Editorial comment appearing in the Sibley Journal of Engineering and the Wisconsin Engineer brings the import of the above subject forcibly to our attention.

From the time of our matriculation we have heard from all sides, "Engineering is a very difficult study," "You are very busy," "You have to work very hard to get through here," and so on, ad infinitum et ad nauseam. The engineering student has plenty to do. Yet he finds time for athletics, music, fraternities, and numerous other activities. Quite a large number of our students work after school. The Y. M. C. A. rooms and the front steps have a great popularity among story-tellers and smokers at all times of the day. Does this look like overwork?

The engineering curriculum when compared with that of other professions is probably as difficult as any; and it is probably with the idea of stimulating the students to greater scholastic efforts that faculties stress the difficulties of the curriculum. However, the trouble is that either this idea is over emphasized, or that we are particularly receptive to this idea as a means to a self pity and a gratification of our vanity as "hard workers." We permit ourselves to become convinced of the difficulties of our school work, and the idea is allowed to remain uppermost in our minds.

The Sibley Journal says: "Somehow an engineer seems given over to grumbling about his plight; yet it is his own wish that he persists in the course that he is pursuing, for a change is nearly always possible. Too often he bores his friends with a weird and exaggerated account of work he has had to do. Practically always when a group get together for an informal discussion, a joy-killing engineer tries to arouse some sympathy for his fellows.

"This is something worth avoiding in the coming year. True it is that our course has well earned the reputation of being as difficult as any, and little harm can come of our discussing the subject among ourselves, arguing one way or another over the apparently abusive or unfair details. But where the serious objection comes in is in grumbling over the details to others."

Not only should we not allow ourselves to grumble to others about our plight, but we should educate ourselves in the fact that our chosen field of education, both as to kind and place, is certainly not the worst in the world. Little imagination is required to think of worse plights.

In other words: Quit grumbling!

ABSTRACTS

M. H. Cooper, *Editor*

Notes on the Foreign Car Show

Soothed and quieted by the soft strains of pleasant music, we tiptoed through the Automobile Salon at the Drake Hotel, and were awed and impressed into the proper reverence by the fine cars and no less by the imposing salesmen, each complete with wing collar and spats. (The salesmen, not the cars.)

The German Mercedes was there as well as the Minerva of Belgium and the Rolls-Royce. The American cars were represented by Stevens-Duryea and Cunningham. The Isotta-Fraschini of Milan, Italy, was presented in a body display by Fleetwood, and the body manufacturers were there in full force, even to the Pullman Company. The hand sped to the pocket with a subconscious impulse as we spied a Pullman porter on hand with his ever busy dust rag. Other body displays were made on Lincoln, Packard, and Locomobile chasses.

The most notable feature of mechanical interest was the Mercedes four-cylinder motor equipped with a supercharger. The supercharger is a device for pumping the charge into the cylinder at a pressure higher than that of the atmosphere, and was designed originally for aeroplane motor practice where difficulties in intake valve action were encountered due to the rarefied atmosphere when flying at high altitudes. The motor is a fairly small one of 164 cubic inches displacement and is rated at only ten horsepower, a typical rating for small English and Continental cars. The supercharger is not used at low speeds such as are used in city traffic, but it automatically comes into use upon pressure of the accelerator above a certain speed. Thus, it is claimed, the inefficiency resulting from a powerful, high speed engine running at half capacity and idling speeds is eliminated and lower gasoline consumption is effected. At the same time with the supercharger the motor will develop sixty-six horsepower with pump-feed water cooling. The effect is, as the makers put it, two motors under one hood. There is also in the Mercedes line a larger chassis equipped with a six-cylinder Daimler aviation motor. The distinctly European appearance of the car is preserved by the Mercedes pointed radiator and outside exhaust pipes, and more particularly on the closed models, which have the windshield sloped forward over the hood instead of being placed vertically or sloped slightly backward as in American practice.

The Continental engineers seem to have adopted the four-wheel brake idea as heartily as our own designers and the Minerva heads the list with twenty-four-inch brakes front and rear. The motion of the foot-pedal is transmitted by steel brake rods to an intermediate equalizer rod for each set of brakes, whence it is transmitted to each brake respectively through four helical springs of equal scales by flexible wire ropes. This eliminates the possibility of one brake or set of brakes locking before the other has had a chance to operate and promotes uniformity of action. The Minerva uses the extremely long, cantilever, rear springs so typical of European construction and noticeable in Rolls-Royce and Renault.

In contrast to the long, low, battle-cruiser appearance of the Minerva is the high, slim greyhound in the Isotta-Fraschini. The hood, which covers a straight-eight motor, is high and narrow and constitutes almost half the length of the body. The appearance is somewhat similar to that of the Fiat of a few years ago although the Isotta is undoubtedly much lighter. The body placed on the car was a beautiful town cabriolet by Fleetwood, made of metal and finished in pale coffee color.

Commercial Aviation

(Prepared expressly for THE ARMOUR ENGINEER by William B. Stout, of the Stout Metal Airplane Company.)

Commercial aviation has not yet begun in America. We have had twenty years and more of military plane development fostered mostly by government interests and interference. Commercial aviation in America is just being born.

There is as much possibility of making money operating a military type of airplane such as the F5L or JN4 military transports, as there is of paying dividends on the operation of a battleship as a passenger carrier. If the battleship is full of TNT you have about the safety factor of the military airplane as well.

Commercial planes are designed first for safety, second for cost, whereas in military planes little attention is paid to either.

The military pilot is a risky fellow who enjoys doing stunts and thrilling the passengers with hair-brained stunts, and who, on alighting from an inter-city trip, lets out as his first remark, "Where can I get a drink?" The commercial pilot is a steady, home-type of individual, who is reliable in a business way and as far removed from the harum-scarum type as red from violet. The military pilot is instructed in gunnery, acrobatics, the recognition of enemy ships, and in the taking of risks. The commercial pilot goes through a course of meterology that he may understand weather conditions, and he is thoroughly instructed in wireless sending and receiving. He is given a course in navigation with particular reference to the route over which he is to fly, and is schooled in every item that will add to the safety of that particular route.

The military pilot's rating is gaged by the number of enemy ships he brings down, with no reference to his crashes. The commercial pilot's pay is based on the number of hours he has flown in service without an accident. An accident sets back his pay to prescribed rates, depending upon whether it is a broken landing gear or a wrecked ship. This has been the means of eliminating accidents in Europe as well as on our own airlines. Fokker airlines have operated for four years without an accident.

Our Air Mail has recently completed 2 million miles of flying between New York and San Francisco. It has operated for better than four years with the remarkable record of 96.7 per cent on time during all of last year. If this can be done with the present type of stick-cloth-and-wire planes, constructed by the tent-and-awning business, what can we expect when we have real airplanes of all metal construction, with maximum safety, lightness, and strength, operated under proper conditions and controlled by commercial management rather than the government.

War planes such as the Martin Bomber can carry twelve people at eighty miles per hour cruising speed at a cost of about one hundred dollars per hour. Modern commercial planes of half the horsepower can carry the same load twenty-five miles an hour faster at a cost of thirty-five dollars per hour, including gasoline, oil, pilots' fees, landing field, wireless and weather reports, insurance, overhead, interest on investment, ticket selling, advertising, etc. Even this will be cut down materially as tonnage increases, so that eventually it will be possible to carry passengers at railroad rates, and make money.

The new passenger planes are muffled and enclosed, comfortable as a Pullman car, fitted with every convenience for traveling. The newer type will be seen on landing fields at various meets for the first time this year.

Commercial aviation is already started and, having so much more to build on, will develop more rapidly from now on than did the motor car.

A New Fuel Injection System

A fuel injection system making possible the use of heavy fuel oils, such as furnace oil, in internal combustion engines has been developed by the Hammer Spray Company under the patents of S. A. Hasbrouck. Fuel is injected into the cylinders by means of a specially designed pump, which has one cylinder for each engine cylinder, through a spray nozzle in the wall of the combustion chamber. The spray nozzle is connected to the pump by tubing. The pumps are of the plunger type and are operated by a spring under moderate tension and by a trip cam mounted on a shaft, driven from the crankshaft by chain and sprocket or by gearing. The spring actuates a trip hammer which delivers a blow to the pump plunger. The stroke of the pump can be varied by means of a hand lever, and the timing of the injection can be changed while the engine is running.

When the pump plunger is driven down by the blow of the hammer, the proper amount of fuel is forced through the tubing and delivered in a very fine spray, between the valve seat and the valve head, mixing with the air which has been drawn in. Injection of the fuel occurs toward the end of the compression stroke, which, according to Mr. Hasbrouck, is probably the reason that no trouble is experienced from preignition and detonation. The spraying of the fuel is said to be so energetic that no difficulties are experienced even

(Continued on page 118)

SOCIETIES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The meeting schedule adopted by the American Society of Mechanical Engineers was rigorously adhered to, as was also the policy of public speaking by our members.

So far this year we have enjoyed very many interesting talks. An extremely entertaining one was given by Mr. Allen Joseph on "A Trip Through Europe." In this discourse he presented his own experiences in a most constructive way.

Mr. E. E. Johnson in a short talk described "Different Methods of Shoring." He laid special stress on the different types and designs of jacks used and their applications to different forms of work.

Mr. A. I. Newman's talk on "Four-wheel Brakes" also proved very interesting and educational. He described the different systems used and the advantages and disadvantages thereof. We are very thankful to Mr. Newman for his work along this line and as a result of his talk feel much more familiar with this widely discussed current topic.

Other interesting talks were: "Lighthouses," by Mr. C. A. Rife; "Desk Manufacturing," by N. B. Olson; "Automatic Train Control," by W. S. Johnston, and "Welding," by C. Bockman. The last topic proved extremely instructive.

At the present time we are making arrangements with the Westinghouse Electric and Manufacturing Company to obtain a series of lectures and slides which are distributed by their Educational Department. Mr. Emerson B. Roberts, who is in charge of this department, has promised to have our first set of slides ready for presentation on February 28, 1924. The presentation of these lectures and slides are entirely in the hands of the members. We feel that this step will stimulate interest and help accomplish the purpose of the society.

VAUDEVILLE NIGHT

March 26 is the big date for the Dramatic Club. On that date the club will give its first production under the direction of J. V. Hogan. Jack has had considerable experience in the histrionic field and we expect big things from him in the coming event. The repertoire of the club is large and of excellent quality. Some of the members of the colored organization of the Frosh Frolic have taken a liking to the art and will appear again in an act which is both novel and entertaining. Some of the best talent of the Glee Club will also appear.

The music for the occasion will be furnished by a snappy jazz orchestra that will make your blood run two ways at once.

The Dramatic Club has among its members, Floyd E. Brown, professionally known as "Mirza, the Modern Mystic." On the Vaudeville Night program Brown will give some of the latest developments in the art of legerdemain, including escape-work, fire-eating, and other specialties designed to prove "that the hand is quicker than the eye." He has two able assistants in W. H. Baldwin and J. N. Glover, who will appear with him in his act.

This is the first production of the Armour Tech Dramatic Club and on it hinge all hopes for future productions. The success of this event depends on the student body of Armour Tech as well as upon the work and ability of the members of the club.

Floyd Brown, alias "Mirza, the Modern Mystic."

Let's all come out and bring our friends, relatives, wives, and sweethearts, and make this a *big* success. The time is Wednesday evening, March 26; the place, the Armour Mission Auditorium.

WESTERN SOCIETY OF ENGINEERS

Since the last issue of THE ARMOUR ENGINEER the program of interesting talks by engineers of note has been continued with very good results.

On December 20, Professor Wells spoke on the construction of the Rock Island bridge over the Mississippi. He described the process of removing the old span and erecting the new one. The talk was illustrated with slides. Since Professor Wells' specialty is construction of this type, the talk was unusually interesting to the students.

At the next meeting Mr. U. L. Barrett, who is a lawyer by profession, entertained for a few minutes by mentally extracting cube roots of numbers with as many as twelve digits. Then Mr. J. Van Wakeman, of the Bureau of Streets of the City of Chicago, spoke on the Chicago type of pavement. He stressed the practical side of pavement design and construction, especially the use of surveying instruments. He described the design of street crossings, and the legal difficulties connected with a paving project. The meeting was the longest, in point of time, of those held this year.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

If this were an ordinary year we would begin this write-up as follows: Armour branch of the A. I. Ch. E. held its annual smoker on Thursday evening, February 21 at the Phi Pi Phi house. The smokes, eats, etc. . . . A good time was had by all.

But 1924 has a particular significance to the chemical department, in that it finds Professors McCormack and Freud in their twentieth year of service at A. I. T. It was the privilege of the Society to honor these men, as befits their efforts and success, at an affair which offered inspiration as well as entertainment.

When all had gathered at tables set with refreshments, President Brady, as representative of the students, set forth the purposes of the occasion. He presented Professors McCormack and Freud with wallets, gifts of the Society, in token of the esteem and respect of their students.

President Raymond and Dean Monin, associates of the guests of honor, then commented briefly upon the great part Professors McCormack and Freud had played in the development of the chemical engineering department at Armour Tech. Our guests of honor responded with their personal reflections after twenty years spent in the department. It was here that their splendid spirit and high purpose were so strongly evident that we sat inspired and humbly grateful that we were the ones who had had the pleasure of honoring our leaders.

Congratulations and handshaking all around ended the evening, as Professor McCormack hurried to catch a train which carried him to some place where they were waiting to find out "how it should be done."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Armour branch of the American Institute of Electrical Engineers holds its regular meetings on the first and third Thursdays of every month at 11:30 A. M. At these meetings the regular business of the Society is carried on, together with talks and demonstrations from men who are leaders in the electrical field. We have been very fortunate this year in obtaining speakers for our meetings, and the members have indeed learned a great deal from their discourses. The Society also aims to train its members in getting before an audience and talking on some technical subject. Two purposes are thus accomplished, one in the manner of making a public speech and the other in learning of subjects that are not included in our textbooks.

The Society can now boast of having a membership of nearly one hundred per cent of the Sophomore, Junior, and Senior classes. Our work along this line has been helped very materially by the generous help of Professor Moreton to whom we are deeply indebted.

Success is only doing well,
And with a master touch,
The little tasks that others think
Do not amount to much.

ATHLETICS

O. M. Spaid, *Editor*

ARMOUR TO SEND MILE RELAY TEAM TO PENN STATE RELAYS

Since the start of the second semester a group of a dozen or more engineers have been "slushing" out every night to Bartlett Gymnasium of the University of Chicago in an attempt to make something out of themselves other than possible engineers. With the Illinois Relays on March 1 as the immediate incentive, the men have trained conscientiously and the final reports indicate that the Armour Tech relay teams may be seriously reckoned with. As the Illinois Relays is the first meet of the year the showing is entirely problematical but on the twelve-lap track at Bartlett Gym., five men are running the quarter mile in less than 55 seconds, while the mile relay has been run off in 3:41 1/5. The time for the mile relay at the 1923 Illinois Relays was a new record of 3:35. From these figures it would seem that Armour Tech has a combination that may sling *some* cinders when they get on the track at Illinois University and run against competition.

It is very seldom that a small college can furnish four half-milers of any quality and as a result the two-mile relay is not as popular as the mile relay. In Payne, Berry, Robinson and Hoff, however, Armour has a team that with very little training has averaged 2:10 for the half mile. Payne, Berry, and Robinson, are veteran distance men, and Hoff has been temporarily taken off the 440 squad to make the fourth man. These men with the mile relay team consisting of Goers, Long, Owens, and Spaid, will make the trip to Champaign.

On March 26, the Central A. A. U. Indoor Meet will be held at the Broadway Armory and Coach Phalen is expecting to enter his relay teams and possibly a few individuals. This meet draws the best material in the central west and the competition is always strong.

The big track event of the year is the Penn State Relays at Philadelphia, April 26. It has been the ambition of those at Armour who are interested in track in particular and athletics in general, for Armour Tech to be represented in one of the really classic meets of the year. Until this season none of the track teams were strong enough to furnish a good relay combination but with the surprisingly fine showing made so far it appears that Armour Tech is about to realize that ambition. An appropriation has already been alloted for the trip and everyone is watching the results of the Illinois Relays and the Central A. A. U. Meet. If the mile relay team shows up at all in these meets it is almost certain that they will go to Philadelphia.

It has been said that the general impression of Armour Tech in the east is that the Institute is in some way directly connected with the stock yards and that the students wipe the blood off their hands on a towel and then stride solemnly into a calculus class. When the basketball team went to play Detroit University in 1922, the "Detroit Free Press" had an inspired article on the ferocity of "the Butchers" which is rather indicative of the general public's idea of Armour Tech. There is no better way in the world for Armour to prove that it is a vital, progressing institution, and interested enough in things other than purely engineering to send a representation to the Penn State Relays. It cannot be denied that a considerable portion of a college's publicity is due to its athletics, and here is the opportunity for Armour Tech to place its name among those of eastern colleges with the demand for serious consideration in the athletic world. The Penn State Relays have a relay for technical schools only, and in this class Armour will be competing against institutions having the same athletic difficulties.

BASKETBALL

By winning the last three games the Armour Basketball Team is showing the results of persistent effort by the players and good coaching. The results of the games to date are:

Armour, 17; Notre Dame, 29.
Armour, 24; Millikan, 40.
Armour, 17; Loyola, 19.
Armour, 29; Augustana, 27.
Armour, 21; Western State Normal, 45.
Armour, 19; Augustana, 50.
Armour, 26; Detroit U, 21.
Armour, 37; Chicago Tech, 22.
Armour, 33; Lake Forest, 28

With one or two exceptions the games have all been of the kind that make nervous wrecks out of ordinarily imperturbable engineers, with the results in doubt until the final whistle. The Loyola game was a hard one to lose as Armour held the lead throughout the game, only to lose by one basket when the Loyola team took an unexpected last minute spurt. Augustana was slated to defeat Armour in the first game and evidently had thoroughly convinced themselves that such would be the outcome regardless of what Armour might have to say. The score indicates how royal the battle was. However, the usual handicap that Armour teams are under when playing on large floors, and the revengeful spirit of the Swedes were too much for the team when they went to Rock Island, where Augustana won by a large score. Western State Normal, which last year had a decidedly mediocre team, blossomed forth with an exceptional combination of heavy, fast men. Playing on the afternoon of the second day of final examinations they had little trouble in running up a large score. The pendulum of fortune has swung the other way and the Armour Tech tossers have placed three more scalps on their belts, for Detroit University, Chicago Tech, and Lake Forest College have all paid tribute.

The individual points are (exclusive of the results of the Lake Forest game):

	Baskets	Free Throws	Total
J. McLaren, L. F.	35	11	81
Hellgren, R. F.	29	5	63
Brockman, C.	4	5	13
Gaylord, R. G.	5	2	12
E. McLaren, L. G.	5	1	11
Terry	3	2	8
Peterson	..	1	1

BASEBALL PROSPECTS

Did you notice all the noise and excitement up in the Gym the other day? Well, that was the official opening of the new drama, "The 1924 Baseball Season." For about six weeks performances entitled "Spring Practice" will be given, which will be short one-act plays. Following this a series of dramas consisting of nine acts will be presented, although occasionally they may be longer if the actors so decide. Watch for the announcements each week on the bulletin boards.

Professor Henry Penn of the Civil Department is our coach this year and for the benefit of the few who have not heard of him before we will give a short history of his baseball experience.

Professor Penn is an Illinois alumnus and while there he played one year Freshman ball and three years Varsity ball, which was all they would let him do. He was a pitcher and they still tell of how he used to stand them on their ears when they tried to hit the slants he tossed at them. Since leaving school he has played on several of the best professional teams in the country so that he knows baseball from "A" to "Z" and then some. Aside from being a crackerjack player, however, he has the happy faculty of being able to impart some of his information to others; in other words, he's a real COACH! Already he has gained the confidence and support of the men who have been out to the first baseball meetings and his lessons in "skull practice" have been enthusiastically attended and much real benefit derived from them. One point which he emphasizes is the fact that there isn't a man in school who has any particular position cinched. It's up to the player to "deliver the goods" or he will be out of a job!

The schedule is coming along very nicely. Already we have games arranged with the University of Wisconsin, Northwestern College, Columbia College, Augustana, Y.M.C.A. College, and several others, so that from all appearances we are going to have a *big* season, and if the team receives from the student body the support that it should, we will have a *successful* one as well.

Right here it might be well to say a few words about that intangible something called "school spirit." We all undoubtedly have at some time or other played some game requiring a certain amount of skill. And probably all of us have felt that queer feeling of uncertainty, which comes at times when we seem to be lacking in our usual skill. To have a friend come along at that "psychological moment" and give us a little encouragement would probably be all that would be necessary to throw the victory in our direction. So with a baseball team, which after all is merely a composite made up of men just like ourselves, the encouragement of the students, the cheering, the feeling of support, is often a larger factor in the final result than the skill of the players. School spirit is something which we ourselves can create. We will never find this spirit in any institution unless it has

(Continued on page 118)

FRATERNITIES

MORE NEWS OF TAU BETA PI

Beta Chapter of Tau Beta Pi now has 24 active members, representing all of the departments of engineering. This is the largest active membership the chapter has had for some time, and its influence at old A. I. T. is bound to be felt for the remainder of the year.

The present problem of the chapter is to firmly establish in the mind of the school at large the purpose of Tau Beta Pi. Too often in the past has the brotherhood of Tau Beta Pi been subjected to misinterpretation. The purpose of Tau Beta Pi is to mark in a fitting manner those who have conferred honor upon their Alma Mater by a high grade of scholarship and to promote a spirit of liberal culture in the school. Scholarship is thus an essential to membership, but it merely limits the number of eligible candidates. The qualities of character, loyalty, personality, and school activity, determine the final desirability of membership, since they mark the finished man; while scholarship, of itself, may be to a large extent mechanical in its nature. The hearty support and co-operation of all Tau Beta Pi men is pledged to all school activities.

Attention will very soon be focused upon the spring elections from the upper one-eighth of the Junior Class. The members of the class are being scrutinized rigorously, since from its ranks will come the future membership of Tau Beta Pi. The results of the election to membership will appear in the May issue of THE ARMOUR ENGINEER.

The present officers of Beta Chapter elected at the first meeting of the semester are as follows:

President, R. M. BECKWITH
Vice-President, E. E. MCLAREN
Corresponding Secretary, F. R. NELLE
Recording Secretary, H. C. FRIEDMAN
Treasurer, C. F. KAUTZ
Associate Editor of "The Bent,"
C. A. STIEHL

PHI LAMBDA UPSILON

Omicron Chapter wishes to announce the initiation on Decemher 21, 1923, of the following pledges, into active membership:

SENIORS
K. STEINER
C. A. RIETZ

JUNIOR
M. F. ADAIR

On Friday evening, January 11, 1924, the Fall Initiation Banquet was held at the University Club in honor of our new actives. The affair left all present with the memory of an evening well spent.

The chapter is busy considering the eligibles for membership and will shortly announce the election of men from the Junior Class.

ETA KAPPA NU

Eta Kappa Nu is the honorary electrical engineering fraternity organized in 1904 at the University of Illinois. Since its conception and organization the growth of the association has been of that type which assures a long and healthy life. There are now eighteen active chapters at representative universities and colleges throughout the country. It is seen that the guiding principles are being followed with concerted effort toward the common end which can only be accomplished by such active co-operation.

Members elected to and initiated in Eta Kappa Nu last semester were:

SENIORS
C. L. KEENE
C. J. BUCK
C. S. SHAFFER

JUNIORS
H. H. CHUN
E. M. MEYER
W. J. PATTERSON
A. S. STEMWEDEL

We wish to repeat here the announcement of the competitive writing open to students of the Sophomore Electrical class. The subject is to be of the competitor's own choosing but must pertain to engineering. The prize is to be a Standard Electrical Handbook, awarded to the author of the best paper by a special judging committee. The length of the paper is to be between five hundred and fifteen hundred words and must be handed to Professor Stryker by May 1, 1924. The winner of the competition will be announced by Delta chapter of Eta Kappa Nu the following week.

CHI EPSILON

This semester's activities began at a meeting held on Tuesday, February 19, with but one of our brothers, A. J. Zelenka missing. Brother Zelenka returned to Armour Tech in September, 1923 in order to complete his college training which had been set aside for one year while attending to his contracting business.

At this meeting the list of men eligible to the election this semester was read. Those who have the requisites for membership, which are scholarship, sociability, and practicability will be elected to membership.

The results of this election will be published in the May issue of THE ARMOUR ENGINEER.

The officers for this semester are:

President, E. L. NIEDERHOFER
Vice-president, R. J. RASMUSSEN
Secretary, L. H. PFOHL
Treasurer, R. B. BERRY

SIGMA KAPPA DELTA

Sigma Kaps' anticipations were more than realized at the Christmas party held at the House on December 21. Holiday decorations included just enough mistletoe to make the evening interesting.

After the holidays, the first break in the routine of classes was an informal House Dance on February 1. Jenks Bryan's Band satisfied the most critical judges of dance music.

All alumni are urged to be at the House on Thursday evening, February 28, when the Alumni Chapter will hold a business meeting preceded by a dinner.

The faculty is invited to the faculty smoker to be held at the house on the evening of March 14. We look forward to the smoker as an event at which we really get to know our professors, and they see us in our "native element."

TRIANGLE

Armour Chapter of Triangle held its first initiation on the afternoon of February 2, at which time five men were initiated into active membership and one into alumni membership. Our new brothers in the active chapter are: Loren Swartz, '24; Cliff Larkin, '25; Nig Prendergast, '25; Nemo Niemz, '26 and Carl Reutter, '26. Carl Carlson, '23, a Civil graduate, and one of the most active workers in our organization during the days of its inception, was called out of town at the time of our installation last May. Carlson recently returned to live in the Windy City and became initiated into our alumni membership. The initiation banquet was held at the Lakota on the evening of February 2. Six of the other eight chapters of Triangle were represented, and of our own alumni we had with us Harold Munday, "Swede" Johnson, George Goedhart, Harry Vickers, Ben Morrison, "Jerry" Williams, and Fred Klemp, all contributing to liven the occasion by telling us engineers of the great future in the profession.

Triangle lost three men in mid-year. Tony Zelenka completed his course in C. E., Montgomery dropped the pursuit of Math., and Treff left us for a semester, expecting to be at home in Colorado until next September.

Of our class of '24, excuse us if we mention that the nine are loaded down with eleven honorary keys.

Stag affairs are a frequent occurrence at the house, so much so that those more serious occasions, such as dances and parties, are not missed. This calls to mind the fact that we have a regular bachelors' club, but its membership is awfully limited. Also it might be here mentioned, since stag affairs are the subject, that the Faculty of A. I. T. will be our guests at a smoker to be held Friday, March 28.

PHI PI PHI

The boys started off the new semester with plenty of "wim, wigor and witality." The object being that a good start is half the battle.

The annual smoker of the Armour branch of the American Society of Chemical Engineers was held at the Phi Pi Phi house on February 21. Talks by the faculty, smokes, refreshment and music (?) by the "chemical orchestra" served to entertain those

"Who think without their products we would all be in the lurch
Who have heathen idols which they designate research,
Who tint the creeks, perfume the air, and make the landscape drear,
The stink evolving, grass dissolving, chemical engineer."

The following day, Washington's birthday, was the date of the annual initiation of the chapter. Many of the alumni, faculty, and pledges were initiated. The

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THE ARMOUR ALUMNUS

(Continued from page 101)

at the Michigan Central depot, escorted them to the Fort Shelby Hotel where we had made reservations and entertained them with a luncheon at which were present twenty-three men.

In the evening we attended the basketball game at the University of Detroit, and I am very sure that the local university fully realized from the reception given the Armour team and the noise which we made, that Armour had considerable moral support. We hope it will be our pleasure to make this an annual affair.

In the spring at the annual intercollegiate baseball game Armour was completely represented at the luncheon and the game, and though I do not wish to take unto myself any credit, it gave me great pleasure to see a realization of the hope that I had previously entertained that Armour Tech would be officially known in the intercollegiate association and become a part of the college alumni activity in this city.

Our last annual meeting was held the first Thursday in November, and the following officers were elected for the year 1923-24:

President..... HAROLD S. ELLINGTON, '08
Vice-President..... ALBERT N. KOCH, '14
Secretary & Treasurer..... HAROLD D. GUMPPER, '14

Our secretary's address is 1116 David Whitney Building, Detroit, and we extend a hearty invitation to any and all Armour alumni to meet with us on the first Thursday of each month at the Carleton Cafe.

The annual mid-winter meeting of the Alumni Association was held January 30, 1924, at the University Club, Chicago. About ninety men were present at the dinner and the "get-to-gether" which followed. Dr. Raymond was there and was received with the enthusiasm which his appearance at an alumni function always produces. He knows more of our graduates, old and new, than any other man in the history of Armour Tech, so that his appearance among the alumni always has that personal touch which contributes greatly to the enjoyment of the occasion.

John J. Schommer, '12, was also present; and as a corollary to that statement it should be added that he made a speech. Mr. Schommer is deeply interested in college athletics and there are few who are as well qualified to speak on the subject. As athlete and as game official he has had a long and varied career in intercollegiate athletics, and is much interested in the development of athletics at Armour. He has had an opportunity to observe at close range nearly all of the larger colleges in the middle west, and he believes that athletic endeavor, aside from its obvious benefits to the student body, is a powerful centripetal force holding alumni associations together. Some common interest is absolutely necessary if an organization is to amount to anything, and athletic contests supply this interest in a peculiarly effective way.

Mr. Schommer is anxious to have the alumni take a more active interest in athletic affairs at the Institute. A gymnasium, athletic field, or stadium, has been made possible for many an institution through the co-operation of its alumni. Perhaps as our alumni increase in numbers and in influence they may be able to do something along such lines for the Armour Institute of Technology. The Alumni Association itself would benefit immeasurably from such an effort, because of the unity of thought and purpose which it would generate.

Mr. Schommer is a forceful and convincing speaker and usually starts something wherever he appears. His remarks started considerable discussion and did much to put "pep" into the meeting. Come again, John.

As announced in our last issue, the alumni luncheons are now being held every Tuesday at 12:15 P. M. at the Hamilton Club, Chicago. On some occasions the attendance has been good, but there have been times when it was less than it should be. THE ENGINEER joins with the officers of the Alumni Association in urging all Armour men who can possibly do so to come to the Hamilton Club just as many Tuesday noons as possible and help to make these luncheons a success.

Donald C. Colby, '23, well remembered as our star pole-vaulter of last year, took the biggest leap of his career shortly after graduation. The battleground was "the little church around the corner," and Don carried off all the honors in the person of one Miss Helen Heise, who henceforth shall be known as Mrs. D. C. Colby. The date of this great victory was October 18, 1923. Their little nest is at 8158 S. Green St., and when Helen can spare him he busies himself as sales engineer with the Electric Storage Battery Co. Our most heartiest, Don.

Hirsch Epstein, '20, has resigned his position as secretary of the Hyperho-Electric Flowmeter Company and is now in business for himself. He has formed a partnership with **Louis B. Newman, '21,** and will engage in the manufacture of a specialized line of electrical apparatus for use in the medical profession. Mr. Newman's younger brother, Alexander Newman, a member of the 1924 class, is devoting a portion of his time at the Institute to a laboratory investigation of some of the problems which come up in their business. In this way, they hope to improve their present line of equipment and also add to it from time to time. We extend to the new firm our best wishes for a successful career.

H. W. Munday, '23, has resigned as staff engineer with the Haywood-Wakefield Company, to accept a position as associate editor of *Pit and Quarry*. This is a publication covering the production of all non-metallic minerals except coal, featuring stone, gypsum, sand, gravel, etc. This is a field of work in which Mr. Munday should do well and we are pleased to hear of the change which he has made.

Robert B. Minkus, '21, is engaged in architectural work with Bennett and Parsons, 80 E. Jackson Blvd., Chicago. One of the members of the firm, Mr. Edward H. Bennett, is consultant for the Chicago Plan Commission, and Mr. Minkus is his assistant. In this work he is in contact with all the developments which the commission has in mind for the civic improvement and beautifying of the city.

Robert Mayo, '23, has left the New York Edison Company and is now with the New York-New Jersey Vehicular Tunnel Company. His address is 206 W. 109th St., New York.

A. Appelbaum, '21, served for a time as division engineer for the Chicago and Northwestern Railway Company, located at Chadron, Nebraska. He has now gone to South America where he is engaged in construction work for the Guggenheimer Construction Company, in charge of the work at a copper mine in the Andes Mountains of Chile. Industrial developments in South America present an attractive field for engineering effort, and we are glad to see an Armour man in this relatively new field.

D. E. Willard, '05, is president and general manager of the Allith-Prouty Company and Danville Malleable Iron Company, and president and treasurer of the Decatur Malleable Iron Company. **H. A. Durr, '05,** and **W. S. Furry, '07,** are interested with him in both of these businesses, Mr. Furry being one of the largest stockholders.

From the *Seattle Journal of Commerce*, we note that **Philip F. Apfel,** a member of the first class at Armour is becoming prominent in the industrial life of that city. He is president of the Electric Heating and Manufacture Company which firm he founded in 1915. The firm puts out a line of electric heating equipment, and has just installed their heaters in an apartment building in Seattle, the first in the city to be fully electrically equipped.

Mr. Apfel takes a leading part in the business and civic affairs of his city. He is active in the Rotary Club, Electric Club, and other organizations, and takes a keen interest in the University of Washington, near which his home is located. As engineer, business man, and citizen he is an asset to his community and a credit to his Alma Mater.

W. E. Haynes, '13, is manager of city sales for the Jerpe Commission Company, Omaha, Nebraska. He states that there are several Armour men in the city whom he meets occasionally, but it is difficult to get them together. Perhaps in time there may be enough alumni in or near Omaha to start a local branch of Armour alumni. We hope so.

C. M. Lindsay, '09, is vice president and treasurer of the McGraw Hill Company of California. His address is 883 Mission St., San Francisco, Calif.

Alfred S. Alschuler, '99, has been awarded the gold medal given by the Lake Shore Trust and Savings Bank, for the most beautiful new building of the year 1923 in the north central district. Mr. Alschuler won the award for his design of the London Guarantee and Accident Building, the decision being based not only on the architectural value of the building, but also its importance in the development of the city of Chicago, and the architectural knowledge shown in the plans.

"Gene" DeBra, '23, is in the radio business at Long Beach, Calif. He is the head of the firm, DeBra Radio Installations.

George Goedhart, '23, recently departed for Toledo, Ohio, to accept a position there as superintendent of construction for a contracting and building firm.

H. W. Herbst, '22, is at Columbia University, engaged in graduate work.

C. W. Muehlberger, '20, is State Toxicologist at Madison, Wis. He has obtained his M. S. and Ph. D. degrees at the university there.

THE SLIPSTICK

CLAUDE ALBON STIEHL, *Editor*

THE PAUL REVERE OF THE MINUTE

Part One. The Start

Listen my children, and you shall hear
Of the wild joy ride of Paul Revere,
On the eighteenth of April, nineteen
twenty-five,
Of course not a man is now alive
Who has lived thru that famous day and
year.

He said to his friend, "If the Kluxers
dash
To the Friars Inn or the Rainbo tonight,
Just give me a tip with a radio flash,
And I'll put a kink in their plans all
right!
One if by Ford, and two if its free,
And I'll pick up the news with my
antennae,
Ready to jump in a yellow cab,
And what with a horn and a gift of gab,
I'm pretty sure that their act we'll crab!"

Then he said, "So long!" as he jumped
thru the door
Of a noisy L for the far North Shore,
Just as the bells began to ring
Ere the Wells Street bridge made its
upward swing,
To hold up the traffic an hour or more;
A ponderous bridge with each girder and
beam
The achievement of some engineer's bad
dream,
And a dangling lantern on either side
That showed it was open full and wide.

Meanwhile his friend thru alley and
street
Wanders and watches with eager ears,
'Til out of the roar around him he hears
The sound of a traffic whistle's squeal—
The grind of brakes, and the thump of
feet
And the rattle of joints as a street car
nears,
Staggering down on two rails of steel.

Then he came at last to the Wrigley
tower,
And didn't bother to climb the stairs;
Instead, by elevator up he tears,
And startles the pigeons from their bower
On the Corinthian columns that round
him made
A Roman architectural glade.
Up the broad stairway—handrail and all,
Even a dowager couldn't fall,
Where he paused to listen and look down
For an hour or two on the lights of the
town,
And the smoke outpouring over all.

Meanwhile, impatient to give 'er the gas,
Mufflered and goggled, with his weekly
L pass,
At the Evanston limits parked Paul
Revere.
Now he gave the engine a turn,
Now fitted the phones to his waiting ear,
Then, impetuous, honked the horn,
And eyed the cops with a look of scorn.
But mostly he watched the steady glow
Of the vacuum tube of his radio.

And lo! as he looks, he suddenly hears
A static scrape, then the whole air clears!
He springs to the wheel, the self-starter
he shoves,
But lingers and listens while buttoning
his gloves—
'Til the Bed Time story meets his ears!

The clanking of chains is all we hear,
The snap of the springs as he hits, a rut,
And beneath, on the concrete, in passing,
a nut
Dropped out by his flivver somewhere in
the rear.
That was all! And yet, ere he'd left our
sight,
He paused to give his last Camel a light!

*(To be Continued in our next—
Subscribe now.)*

THE EXTENSION COURSE IN THE COLLEGE OF ENGINEERING FOR THE YOUNGER GENERATION

LESSON NUMBER THREE

THE ART OF GRAPHING

1. *Defin.* — "Graph" — Any piece of paper with some of the lines going in right-angled directions and some more lines going in any direction.

2. *Defin.* — "Curve" — Usually a series of straight lines badly disjointed—and very rarely curved lines—trying to find their way from one corner of a graph sheet to the other.

3. *History.* — There is born in every man a desire to express himself artistically, and even in that much maligned person, the engineer, we see the faint flame flickering—struggling eternally for the expression that it can never fully realize. So through the ages, the engineer, like all men, has put down his idle fancied in straight and curved lines; yet, whether on the walls of telephone booths or between the lines of his physics notes, these engineers' drawings have always shown an intense restraint. Scorning the use of color and brush, paint and palette, they have developed a school and a style of their own which they have elaborately and consistently worked out under the name of "graphing," and these drawings they call "graphs."

In the early days, these so-called graphs had no meaning whatsoever—they were simply the products of artistically aspiring, but totally untrained individuals in the engineering profession. But the engineer was not long realizing that his art could hold no place in the rivalling field of the painter and architect unless he established one thing that would place his works in a class by themselves, and that one thing was, to attach a meaning to his work. Yet the engineering mind, quite logically, found no sympathy with such titles as, "Azure Dawn," so we find instead his products are titled with such names as "Diphtheria Rate in Omaha," and "Sanitary Improvements and the Effects on Cattle," and so forth.

The fact that these drawings are far more abstract than the futuristic and cubistic works of our most modern artists is proven when one looks at a typical graph, and finds it seemingly representing a cross section of the Swiss Alps, yet discovers its title to be "Fuel Consumption of a Gasoline Engine."

Also, it is true, that the art has developed so highly, that a graph can only be produced at the cost of a great deal of labor and computation. Unlike the average artist, who merely paints what he sees, and a lot that he doesn't, and who can picnic beside babbling brooks and fair haired models, the engineer must isolate himself to compute the tables and columns of figures that are so frequently involved in the production of a single simple graph; and although it would seem to the layman that anyone could put a few points on a piece of paper and then connect them with curved and straight lines, we have it on the authority of many engineers, that such a work may have the *appearance* of a graph, but it lacks the proper technique, and, most terrific sin of all, "does not mean anything."

4. *Graphs vs. Art.* — It is not within the scope of this work to enter into a discussion as to whether art must or must not have a meaning, or whether something with no meaning can be art; this much, however, is evident, that no engineer believes the painter's art is as valuable, and therefore, as great as his own—the artist, however, does not believe a graph is art; therefore, the two paths are irretrievably separated and each must be judged in its own field. Like all such discussions, we are back where we started.

5. *How to Make a Graph.* — First take a sheet of cross-ruled paper, sometimes called graph paper, and assume a title for the picture. (*Note:* It frequently occurs that the title is not determined until after the graph is drawn, but this practice is not recommended by the best engineers.) The subject of the picture must always have at least two or more factors that may or may not bear some relation to each other, for example, we might choose to depict "The Number of Fords Sold in Relation to the Death Rate of Eskimos." Here, the Fords would be put in one column and the Eskimos in another, and the points where they met would determine the death rate.

6. *Points to be noted in Making an Expert Graph.*—

(1) Several colors of ink may be used. These enhance the interest, and where the lines cross, give a peculiar and delightful color shade and unusual blending effects.

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PORTLAND CEMENT CONCRETE

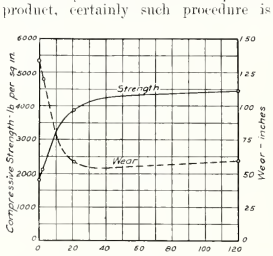
(Continued from page 96)

tions will lead only away from obtaining the maximum value of the material with which we are working. Practical application has not kept apace of truths established by scientific investigations. The profession should grasp the importance and seriousness of its trust and assume the responsibility of obtaining in the concrete structures, that quality of workmanship, materials, and resulting product which are assumed in design, and called for in the specifications. Given a standard cement, more attention should be directed toward the design of the concrete mixture by scientific principles rather than by arbitrary judgment.

The control of the variables entering into the composition of good concrete is vastly the important factor. It is difficult to conceive the necessity for further complicating the results already possible with the single constant, portland cement, by the introduction of integral mixtures or by varying the quality of the cement. To confuse the work with additional special cements, when everything possible to gain with the use of the standard cement is not yet being obtained, is both unnecessary and uneconomical. Special instances or conditions may warrant the great additional costs of special cements but such cases are remote and include at most only a very small fractional part of the total output of the standard product.

European manufacturers of special cements are fortunate in having at hand an unlimited supply of raw materials of such composition and consistency as to require only few and economical operations in reducing them to usable form. In the United States the supplies of raw materials containing the desirable chemical characteristics are scattered and economically unavailable. In physical composition our raw materials are for the most part hard and harsh, involving expensive grinding operations, largely absent in the case of the foreign methods. To readjust domestic processes for the manufacture of special cements would mean a complete readjustment of the present manufacturing system.

Before such a step is taken it may be well to analyze some of the practical considerations involved. In the United States there are at present some ninety odd manufacturers of portland cement, having about 115 plants located at various points throughout the country, convenient to the markets which they serve. These plants have been designed to make most readily, and therefore with lowest cost, a product embodying certain standard requirements of uniformity and quality. If certain of these plants would devote themselves to the production of one quality, while others to other qualities, there would result a necessity of shipping a heavy commodity over long distances at almost prohibitive freight rates, the latter being even now a very substantial item in delivered cement prices. So long as the present methods of concrete manufacture do not take advantage of the full possibilities of the present product, certainly such procedure is



Keeping concrete damp the first ten days adds 75 per cent to its compressive strength. It reduces the amount of wear 40 per cent, or vice versa, increases the resistance to wear 65 per cent.

From Bulletin No. 2, "Effect of Curing Conditions on the Wear and Strength of Concrete." Structural Materials Research Laboratory, Lewis Institute.

unwarranted. That standard cement has failed to do the required work has as yet not been demonstrated. It is easy to criticise the cement for concrete troubles when in fact the principal omission is in the aggregates or workmanship.

Some years ago a group of American contractors became interested in reports of what then appeared to be exceptional results being obtained in Italy by the use of a special cement, known as "Soliditit," in highway construction. Concrete hardened more rapidly and resistance to abrasion was thus early set up, which fact permitted traffic upon these roads much sooner after completion than was possible in the United States.

Investigations of this cement and of the specifications for the concrete in which the above results were being obtained showed conclusively that the added advantages claimed for its use were in reality due to the mixtures and method of manufacture of the concrete. In the instance of the Italian construction cited, the mixture used may be expressed volumetrically as 1 part cement to 1¾ parts aggregate, grading from ⅜ to 1½ inches. The concrete specifications called for an extremely dry mixture, the water-cement ratio being about 0.40. This, of course, necessitated considerable tamping, which the specifications again covered by providing the concrete to be placed in thin layers and vigorously compacted.

That the results claimed were entirely due to the proportioning and manipulation was proven by a parallel series of compression tests of "Soliditit" concrete and domestic portland cement concrete. The former gave strengths ranging from 3,540 lb. per sq. in., at 7 days to 5,640 lb. at three months. These values were 71 per cent at 7 days, 75 per cent at 28 days, and 82 per cent at 3 months of the strengths of concrete made according to the same formula but using domestic portland cement.

Using a concrete manufactured in the usual manner, a mix of 1 to 4 in a plastic consistency gave results which indicated "Soliditit" cement to be 67 per cent at 7 days, 58 per cent at 28 days and 59 per cent at 3 months, as strong as similar concrete from "Laboratory" cement.

These comparisons served to emphasize the fact that concrete responds in quality in proportion to the skill used in its making. If certain fundamental principles are followed definite results within reasonable limits can be obtained.

Proper selection of clean, well-graded aggregates and simple tests and experiments conducted in the field will quickly determine whether or not these materials are fit for use in the concrete mixture. A sieve analysis will aid in determining in what proportions these should be assembled in the mix so as to produce the highest quality and strength.

The method of mixing should receive careful attention. Mixing water must be clean, free from oil, acid, alkali, and organic substances. Mixing must be continued at least one minute after all the materials (including the water) are in the drum. Too little mixing to speed up quantity production causes concrete of varying density and strength and a "honeycomb" surface is certain to occur. Too much water, producing a "soupy" mixture must be avoided. Concrete weakens in direct proportion to the amount of excess water added. The mix should be as stiff as is possible to work in the particular instance at hand. One pint more water than needed in a one-sack batch decreases the strength and re-

sistance to wear as much as if two or three pounds of cement were left out.

Placing operations should be carried on continuously until the unit or a certain well defined portion of the structure is completed. Frequent delays cause planes of weakness between the successive batches and reduce the resistance to penetration of moisture and frost. Reinforced concrete should be placed with even greater care. The fresh material should be well rodded into place around the reinforcement. Spading the concrete adjacent to form surfaces will produce a smooth, uniform finish. When placing concrete by the spouting method the slopes of spouts should be at least two and one-half horizontal to one vertical. Less incline means more spouting area but additional water is usually added to the mix to make it "flow" down the chutes. Increase in the water content without a corresponding increase in the cement factor results in a weaker concrete and a separation of aggregates which destroys the homogeneity of the mass. Too wet a mixture is evidenced by pools of cement-laden water on the surface of freshly placed concrete. Excess cement carried to the surface in this manner causes dusting in floors and pavements: "pitting" is certain to follow and a general breaking down of the resistance against abrasion will be the inevitable result.

The curing of concrete after placing is as important as its manufacture. Concrete hardens by virtue of the chemical action between the cement and mixing water. If this process of hydration is stopped by too rapid "drying out," the full value of the cement is not obtained. Concrete must be kept wet for a period of twenty-one days or more, either by sprinkling, ponding or covering with earth, straw, sawdust, etc., which is then kept wet during the curing period. Less mixing water and more curing water is a necessary policy to follow if good concrete is to be expected. No wearing surface should be put to use before twenty-eight days after placing.

Protection against the action of the elements must be provided. Prevention of rapid drying out by the intense heat of the summer sun is necessary to assure proper curing. Protection against freezing in winter is imperative. Cold retards chemical action. Hydration of cement ceases when the water of hydration freezes. A frozen concrete is no stronger than the ice that binds the particles. The cement is inactive. Materials (sand, stone, and water) should be heated at the time of mixing. Forms and reinforcement must be free from snow and ice. Concrete reaching the forms at a temperature of 100 degrees Fahrenheit and protected against freezing for a period of seventy-two hours thereafter may be relied upon as safe. The use of so-called anti-freeze mixtures is not to be recommended where the temperature is likely to fall below 25 degrees Fahrenheit. Such materials have some value within given ranges but the abuse and not the use of these materials is where the difficulties usually arise. Under no conditions should anti-freeze mixtures be used in place of regular cold weather methods of heating the materials.

The practice of the foregoing principles in the manufacture of concrete will of a certainty assure a better product. When greater respect exists for the need of care in manufacturing concrete, we will get better concrete. We already know many things in concrete making which should be done, but are not done. Take care of known conditions through greater diligence in the application of standard cement until its possibilities are exhausted. Then only will the universal development of special cements have an economical value in the bulk of modern construction.

NOTES ON AUTOMOBILE BRAKES

(Continued from page 94)

increase the minimum stopping distance about 3 per cent. This factor is equivalent to increasing the weight of a 3000-lb. passenger car by about 100 lb., as regards increase of translational energy. No benefit is possible from this weight increase in obtaining negative traction.

Capacity of Highways

The number of vehicles per hour at various speeds that can pass a given point has been determined by H. S. Swan (Automobile Control, City Planning, and Traffic Regulation, *Engineering News Record*, Feb. 22, 1923, p. 351), the data from which have been plotted to give Curve II of Figure 6. These data were based upon a car length of 15 ft. and a spacing equal to the stopping distance at 8 ft. per sec. per sec. deceleration. The curve shows a sharp peak at 1800 cars per hour, in a single line, at 10 or 11 m.p.hr. car speed.

The influence of braking ability upon the capacity of highways has been treated in an article by W. S. James (*Auto Industries*, Aug. 30, 1923, p. 412), in which appears the curves shown in Figures 4 and 5. The set of radial lines from the origin (Figure 4) shows the maximum deceleration for various "coefficients of friction" of the tire to the road. This relation is shown for various ratios (0.5 to 1.0) of weight on braking wheels to total weight. The relation between the maximum deceleration and safe traffic speed is shown by the curved line of Figure 4.

Figure 5 gives a convenient chart for determining the stopping distances for various decelerations. The editor's note to the article by W. S. James (from which Figure 5 was taken) indicates that cars of the same braking ability can theoretically run end to end, and that there seems to be no need for allowing a space between cars as great as the stopping distance.

It would seem that the important factors determining the spacing of cars are, first, the time required by the rear driver to begin braking after the forward car has started to decelerate, and second, the decrease of decelerating effect that the rear car has over the forward car. With equal braking abilities, ample warning signals, and instantaneous reaction, the traffic could move as a unit and change its velocity without relative motion of the cars in the line. Observation of traffic from above, indicates that this condition is often approximated. The effect of this characteristic is to increase the safe velocity of traffic and also the number of cars passing per hour. The actual traffic stream, however, moves more as an elastic band, with different speeds at various points. The slack and take-up correspond to a straight-ahead snake travel. Should an accident occur with sudden stoppage, there is increased danger when fully utilizing the possibilities of close formation. The only recourse in such emergencies is to turn out of line and introduce other dangers.

Cars having higher or lower braking abilities than the majority of those in the traffic require greater distances between cars behind or ahead of them.

The following method would appear to take care of the additional factors of (a) the relative stopping abilities, (b) driver's reaction time, (c) a reserve safety factor of distance between cars after being stopped, and (d) the car length (assumed 15 ft.).

The numerical values used in this method are not necessarily applicable in practice, but are used to illustrate the method in the absence of practical data of traffic.

Let V_1 = velocity of front car in m.p.hr.

V_2 = velocity of rear car.

a_1 = deceleration of front car.

a_2 = deceleration of rear car.

d = distance between cars in ft.

d_1 = distance between cars after rear driver's reaction time (assumed 2/5 sec.).

l = car length (assumed 15 ft.).

l_1 = a distance safety factor of kV^2 (k assumed = 0.02).

S = stopping distance in ft.

$$d_1 = d - V_2 \times \frac{2}{5} \times \frac{5280}{3600}$$

$$S_1 = 1.076 \frac{V_1^2}{a_1}$$

$$S_2 = 1.076 \frac{V_2^2}{a_2}$$

$$S_2 - S_1 = 1.076 \left(\frac{V_2^2}{a_2} - \frac{V_1^2}{a_1} \right) \quad (10)$$

Introducing the driver's reaction time and the safety factor, safe spacing

$$= (S_2 - S_1) + V_2 \times \frac{5280}{3600} \times \frac{2}{5}$$

$$+ 0.02V_2^2 + 15 = 1.076 \frac{V_2^2 a_1 - V_1^2 a_2}{a_1 a_2}$$

$$+ V_2 \times \frac{5280}{3600} \times \frac{2}{5} + 0.02V_2^2 + 15$$

If $V_1 = V_2$, then

$$\text{safe spacing} = 1.076 \left(\frac{a_1 - a_2}{a_1 \times a_2} \right) V^2$$

$$+ 0.587V + 0.02V^2 + 15$$

With a four-wheel brake car ahead (max. a = 20) and a two-wheel brake car behind (max. a = 10) the safe distances between cars and highway capacity in vehicles per hour in single line on the above assumptions are as given in Table III and Curve I of Figure 6. In Figure 6 an additional highway capacity curve has been added, in which $a_1 = 10$ and $a_2 = 5$ (Curve III).

Table III

M.p.hr.	Car spacing ft.	Vehicles per hour
5	19.8	1330
10	28.3	1870
20	56.2	1880
30	99.1	1600
40	156.5	1350
50	228.8	1160

It is recognized that traffic conditions cannot exist wherein the car ahead always has better acceleration than the car behind. Table III, and Curves I and III of Figure 6, have been based on the latter assumption, and give either a decreased number of vehicles per hour or an increased factor of safety. The assumption of alternate cars with relative braking ability as shown in Curves I and III of Figure 6 will result in increasing capacities with car speeds, ranging from about 15 per cent increased capacity at 10 m.p.hr. to 45 per cent at 30 m.p.hr., and 70 per cent at 50 m.p.hr. Considered in this more practical manner the peak of the traffic capacity curve is about 30 per cent higher, and occurs at 5 or 10 m.p.hr. greater car speed. The effect of alternating the cars having values of 'a'=20 and 10, is graphically shown in Curve IV of Figure 6.

A critical examination of this method, with adaptation to practical conditions would undoubtedly be of value in ascertaining the capacity of highways and the relative value of the various factors. It is of interest to note that some busses have brake hand-levers which operate by pushing instead of pulling. The drivers' reaction time is thus reduced, giving an added safety factor.

The second and concluding installment of Professor Roesch's article will appear in the May issue.

A Promising Engineer

First Prof: There's a lad with good stuff in him.

Second Prof: Let's follow him; maybe we can find out where he got it.

—*Ill. Tech.*

THE PATENT PRIVILEGE IN THE UNITED STATES

(Continued from page 100)

acting under the direction of the Commissioner of Patents.

As to the nature of the contract right conferred on the inventor by the patent it should be remembered that it is not in the proper legal sense a monopoly, inasmuch as monopolies, generally speaking, may be considered as exerting the property right or control over that which has before existed of common right. Clearly this is not true with patents, inasmuch as the same, to be valid, must be new and original with the inventor, and he must have been the first inventor and discoverer of the thing which is the subject of his patent. In other words, he is merely granted the privilege of using that exclusively for seventeen years, in public, which he might otherwise have had the exclusive use of in secret. Letters patent are not to be regarded as monopolies, created by the executive authority at the expense and to the prejudice of all of the community except the person therein named as patentee, but as public franchises granted to inventors of new and useful improvements for the purpose of securing to them, as such inventors, for the limited term therein mentioned, the exclusive right and liberty to make, use, and vend to others to be used, their own inventions; as tending to promote the progress of science and the useful arts, and as matters of compensation to the inventors for their labor, toil, and expense, in making the inventions and reducing the same to practice for the public benefit, as contemplated by the Constitution and sanctioned by the laws of Congress. The opinions of the Supreme Court uniformly agree in holding, with all fair and thoughtful men, that patent rights are not hurtful monopolies but are rights of property at once dignified, honorable, and strong.

It is unnecessary for the purposes of this outline to refer at greater length to the opinions of the great jurists of this country as to the extent and scope of our patent laws, and as to the nature and extent of the inventor's property right in his invention as secured and covered by his patent.

I need not mention that the inventor has solved all these problems upon which the life of our government depended, and that today all parts of our great country, vastly greater than the framers of the Constitution contemplated, are as accessible so far as transportation and communication are concerned, as were neighboring villages in their day.

But it may be contended that most of the great and important inventions of modern times would have been made in any event without the aid and encouragement afforded by governmental reward extended through the Patent Office. It is difficult to conceive that one advancing such an hypothesis can himself believe in it. Can you imagine for a moment that inventors are so much more public spirited than their brothers? Is it so common that men wear their lives away for the sole purpose of benefiting their fellows? I grant there are many such, all too few, but the man who proposes such an hypothesis as that, based as it is upon ignorance of human nature, needs only to study the motives that actuate him in his daily life and he will see conclusively that men are not all philanthropists.

It would be an exceedingly short-sighted policy in any government not to encourage in all proper ways the full, clear, and exact disclosure of all inventions made by the people. It must be remembered also, that it is practically unknown for one individual to produce and perfect a great invention. Instead, practically all great inventions are the product, not of one, but of many minds. They are the products of men who frequently were neither scientists nor mechanicians.

The first step in invention is the mechanical imitation of the hand process. A second and greater step, the restrictive organization whereby simplicity is secured through the multiple use of singly modified elements, places the art, not at perfection, but close to it. After this the development still goes on, and small gains or savings are effected in this or that detail. The great basic inventions in their unimproved states would be worthless to humanity were it not for improvements, many of them apparently of small importance, that have been made thereon.

It follows that even if it be conceived that the primary inventions would have been made without the stimulus of a patent system, there would have been no inducement for other inventors to spend time and money in improving these inventions, without the certainty that if made practicable and acceptable to the public, their manufacture, use, and sale could be controlled for the term of years afforded by the patent. Obviously, if a new device may be freely copied by rival manufacturers as soon as it appears upon the market, no one could afford to spend the large sums of money which are often found necessary in perfecting an invention.

Public policy is, then, the very basis of the patent system and the only reason for its existence. The theory of the Constitution is that patents are granted not as a reward for the past only, but as a stimulus for the future to encourage the making of further improvements and discoveries. To the stimulus afforded by the Patent Office is due the creation of these new industries, and the very great developments in recent years of the older industries. The question of labor is adjusted according to the laws of supply and demand, and the workman displaced in one field finds a new industry for which his previous training most likely especially adapts him. It is to the stimulus given by the patent system that the increase in our exports is largely due, and it is on American invention as fostered by the patent system that we may confidently depend for ability to maintain the high rate of wages paid to American workmen and compete with the world-markets.

While no one force can be properly credited with the entire result, it is undoubtedly true that freedom to enjoy the fruits of one's labor, is primarily accreditable with the enormous advantages which have accrued to the public during these latter decades from the development and extension of the mechanical industries. No force is more potent in this direction than those enlightened laws whereby the inventor is assured a fair opportunity for his reaping a benefit, should he succeed in producing a useful invention. No country, least of all ours, can afford to narrow these wise provisions or restrict their just administration.

TELEPHONE ENGINEERING

(Continued from page 90)

ing inclinations, tastes and training. As a result of this and of the need of the business during recent years, hundreds of graduate engineers, as well as hundreds of graduates from colleges of Science and Commerce, have entered the ranks of the Bell System, and have taken up the telephone business as a life work. In 1923 a total of about 1,000 graduates of colleges, universities and technical institutions became thus employed, and it is expected that this year will see an equal number join one or another of the numerous groups of telephone engineers. It is a profession well worth consideration by those who face the necessity of choosing a life work.

A HISTORY OF ARCHITECTURE IN ILLINOIS

(Continued from page 98)

ment of tomorrow; consequently any building doomed to destruction should be photographed, as no matter how hopelessly out of style it may appear, it is an invaluable commentary on the taste and knowledge of the age that built it. Architecture has added to her role, as the mother of the arts, the added office of historian of the human race.

THE SLIPSTICK

(Continued from page 109)

(2) Relieve the monotony of the drawing by varying the ink technique. Dotted lines and dot and dash lines add an undeniable atmosphere to the work.

(3) Distribute a few circles along the lines at different points. These are supposed to indicate a particularly vital spot, but can be used at any time to denote a certain amount of character and style.

(4) Always place an equation somewhere around on the drawing. This is bound to make it look more scientific and thereby justify its existence.

TRAGEDY

When, after you, the night before,
Have broken off your date,
And o'er your calc did dig and pore,
And cursed your dismal Fate,
That makes you grind and even sweat
To get those problems done—
And finds you toiling at it yet,
Tho clocks strike half-past one.—

When, after you have taxed your brain,
And then have slept too long,
And, breakfastless, you miss your train,
And when one comes along,
You find that due to rain and sleet,
And fog and ice and snow,
It stops at every hundred feet,
Goes *backward*, it's so slow.—

When, by some unknown whim of Fate,
You brazen thru the doors
At thirty minutes after eight,
And have to climb four floors:
Three steps at every leap you take,
And knock down all you meet,
The second—then the third you make—
The *fourth* is 'neath your feet!

Then when the bell rings long and loud,
As down the hall you race,
One of a maddened, frightened crowd,
With fear on every face!—
When to the room you make your way,
And open the door to see:
"No class, the prof is ill today,"
Why—*that* is Tragedy!

AS SOLOMON WOULD HAVE SAID

Verily, I say unto you, my son, become not an Engineer.

For an Engineer is a strange being, and possessed of many Devils.

Yea, he speaketh eternally in parables, which he calleth Formulae, and he wieldeth a Big Stick which he calleth a Slide Rule, and he hath but one Bible—a Handbook.

He talketh always of stresses and of strains, and without end on Thermodynamics.

He showeth always a serious aspect, and seemeth not to know how to smile.

And he picketh his seat in the L car by the springs therein, and not by the damsel beside him.

Neither does he know a waterfall, except for its power, nor a sunset except that he must turn on the light, nor a damsel except for her live load.

Always he carrieth his books with him, and entertaineth his handmaiden with steam tables.

Verily, though his damsel expecteth chocolates when he calleth, she openeth the package but to disclose samples of iron ore.

Yea, he holdeth his damsel's hand but to measure the friction, and kisses but to test the viscosity.

For in his eyes shineth a far-away look that is neither love nor longing—rather is it a vain attempt to recall a formula.

There is but one key to his heart, and that is Tau Beta Pi, and one love letter for which he yearneth, and that an "A."

And when to his damsel he writeth of love and signeth with crosses, mistake these symbols not for kisses, but rather for unknown quantities.

Even as a young boy, he pulleth a girl's hair to test its elasticity, but as a man, he discovereth different devices.

For he would count the vibration of her heart strings, and reckoneth the strength of her materials.

For he seeketh ever to pursue his scientific investigations; even his heart flutterings he counteth at a vision of beauty, and inscribeth his passion in a formula.

And his marriage is as a simultaneous equation, involving two unknowns, and yielding diverse answers.

DOWN AND DOWN

By
Ihaitu Thinkit

(Editor's Note: The natural reticence of the author of these notes prevents his giving more than the barest details of his college experiences, as a more complete account would undoubtedly lead to a campaign against the public production of Student Underworld secrets and scandals. Hence no names are mentioned, and the entire subject matter is made as inconsequential as possible. The Editors trust you will not believe a word of it.)

CHAPTER TWO. HIGHER MATHEMATICS

Yes, the dance was wicked. There was no doubt about it. The saxophone played Bach in the most suggestive manner possible, the bass drum had a lurid pink light in it, and the violinist scraped his horsehair and catgut across one another until my brain reeled. So we returned to a more quiet corner where I could work on undisturbed.

I do not remember what we talked about, except that there were low, sensuous inflections in my voice when I whispered to her the secrets of kinematics, and explained the hidden mysteries of an increment. But she was broad minded, and was not shocked. In fact, she rather liked it, and putting only three chairs between us, said thru her finest pair of teeth, "Do it again!" So we went even farther from the noisy crowd, that foreign eyes might not be near when I showed her my handbook, and explained about the tables and the center of gravity. She liked "I" beams because they were so egotistic, but blushed at the profanity of an "L." It was wrong, I know; probably I should never have shown them to her. For after that, it was necessary to explain the manipulation of my slide rule, and how to calculate, and I showed her how long operations could be performed very quickly by its use.

And then I continued to delve further and further into these mysteries, but when I set the results down on paper, she became very angry. I do not understand just how that came about—but she left me in a rage. Well, women are always hard to understand. I was not altogether to blame. She lured me into it. She whispered the necessity of it all—in fact, *she insisted* upon it.

Yes, I admit I am sorry when I think of it all. And now she says she will never want to know me again! And all because—merely because I *had* to do my mechanics homework at that dance!

ASSEMBLY AT TEN-THIRTY

(Continued from page 101)

ticians, soldiers, senators, singers, men and women who have been leaders in some phase or other of the world's thought and the world's work. Prominent in this distinguished company memory's eye sees a commanding figure; an artist whose medium was the spoken word. Poet, preacher, professor, first president of A. I. T.

The students are now nearly all seated, and the room is filled. On the main floor, freshmen and faculty; in the balcony, sophomores and upper classmen. A gentleman appears at the door of classroom B, and with step dignified and unhurried makes his way to the section reserved for the faculty. Tall, slender, slightly stooped; face deeply furrowed with the cares of many generations of students, but withal a tolerance and kindliness of expression born of the wisdom which the years have brought. "Pa" Phillips, professor of Civil Engineering.

The orchestra starts the proceedings, the members hurrying on to the platform with a do-or-die expression. Professor Phelan, sawing assiduously on his big fiddle, always gets a generous "hand." Mr. Peterson, however, from his seat in the faculty section, regards him with disapproving eye. "No one in my shop ever rolls a saw like that; a perfectly straight stroke does the best work, and in my opinion the sound is also improved."

The selection is finished, followed by a noisy demonstration of approval, bashfully acknowledged by the student leader. Doctor Raymond presents the speaker who receives an enthusiastic reception. A wonderful audience for any public man to face; keen in its appreciation of values, quick to see a joke, sparing of its criticism, generous in its approval. At once an inspiration and a challenge to him who faces it.

At the close of the address a streak, tipped with red, flashes down the aisle and lands with a bound in the center of the platform. "Come on fellows, nine rahs! Make it snappy! Are you ready? Let's go!!" Pep, punch, personality; "Red" Owens, cheer leader. A professor who never was twenty, having begun life at thirty-five remarks to his neighbor, "I wish he had that much energy in the classroom." The other makes no answer but he thinks, "Never mind, Red, you have the quality of leadership, and if you will mix it with hard work in equal proportions it will carry you far."

The orchestra comes on again, looking less determined but more at ease. It is exactly eleven twenty-eight. This time they make the outstanding hit of the day, for when they finish the applause is loud and long continued. A group in the east side of the balcony seems especially appreciative of the efforts of the orchestra and determined upon an encore. The Sophomore class in Machine Design which meets at eleven-thirty. At the close of the second number, Doctor Raymond, watch in hand, and a shrewd twinkle in his eye, steps forword and announces "Classes will resume at one o'clock." The claque has not been in vain.

ABSTRACTS

(Continued from page 104)

in starting from cold on the heavy fuel. The dimensions of the pump naturally must be proportional to those of the engine cylinder. The system is said to be applicable to two-stroke as well as four-stroke engines and to both high and low speed designs.

A test of the Hammer Spray system as applied to an old Knox four-cylinder air-cooled automobile engine has been made by Professor Lockwood at Mason Laboratory, Yale University. The engine was mounted in the car and the fuel injection apparatus was fitted in addition to the regular carburetor so that either the Hammer Spray system with heavy fuel or the ordinary carburetor could be used at will. The road tests demonstrated that the car could be propelled by the use of furnace oil with the Hammer Spray device with substantially the same economy and flexibility as with gasoline.

Figures for the Knox car test with the two fuels are given below. These results were obtained on the rear wheel dynamometer of the Mason Laboratory.

Preliminary tests of Knox automobile, 1912 model, bore 5 inches, stroke 4¾ inches, comparing Hammer Spray system with gasoline gave:

Fuel, Kind	Hammer Spray Furnace Oil	Car. buretor Gasoline
Fuel, specific gravity....	.82	.736
Miles per gal., level road speed 20 m.p.hr.....	16.5	14.7
Miles per gal., level road speed 30 m.p.hr.....	15.75	14.3
Miles per gal., level road speed 40 m.p.hr.....	12.85	11.5
Maximum engine hp., speed 20 m.p.hr.....	16.9	16.1
Fuel rate, lb. per hp. hr., level road, speed 20 m.p.hr.	1.24	1.25
Fuel rate, lb. per hp. hr., maximum load, speed 20 m.p.hr.....	.875	1.19

Professor Lockwood comments that the test results are creditable to the injection device, and suggests possibilities of importance in the substitution of cheap furnace oil for gasoline. These particular tests are regarded as merely preliminary and not showing the ultimate possibilities of the new system when used with high compression.

Motor for Light Airplanes

The light plane enthusiast will no doubt be interested to learn that a particularly well suited engine for light sport airplanes is now available in this country. This engine is perhaps the first serious attempt to develop special light powered units of this class in America. Several light plane engines have appeared in Europe during the past few months, but the light plane development has received considerably more attention over there, as is evidenced by the number of entries in one of the recent meets.

The engine under discussion was built from the designs of Harold E. Morehouse by the Steel Products Engineering Company of Springfield, Ohio. It is an air cooled two cylinder opposed type operating on the four cycle principle. It has a 3-inch bore and stroke giving a total piston displacement of 42.4 cubic inches. It was guaranteed to develop 8 h.p. at 2000 r.p.m., but the power curve shows that 12 h.p. was actually delivered at this speed. Power readings were obtained on a 75 h.p. electric-dynamometer and are possibly lower than such as would be obtained with more suitable equipment. Even so, the power developed was truly remarkable for an engine of this size.

A flange is provided on the crankcase for mounting a housing containing propeller reduction gears so that any desired propeller speed may be obtained. The engine can then be safely operated at speeds around 3000 r.p.m. where an output of 20 h.p. may be expected. The overall dimensions are, length, 12⅜ inches; width, 24¾ inches, and height, 19 inches; and the dry weight without reduction gears, but otherwise complete with magneto and carburetor is just under 50 lb.—*Aviation.*

Declining Production of Crude Oil

The Colorado School of Mines *Quarterly*, for January, 1924, contains an article by Doctor Victor C. Alderson, in which some noteworthy facts are given relative to the present status of the supply of crude petroleum. Doctor Alderson points out the steady decline in the production of crude oil which has occurred during the last few months. On November 3, 1923, the daily average production of crude oil for the United States was, according to the American Petroleum Institute, 2,255,850 barrels per day. By January 5, 1924, it had declined to 1,884,050 barrels per day—a decline of nearly twenty per cent. Doctor Alderson declares, "Thus the drop in nine weeks . . . is so pronounced that there can be little doubt that the peak of production is passed, and that higher prices for crude oil, already effective in certain localities, are an assured fact."

Some light is also thrown upon the status of the naval oil supply, which is receiving so much attention at the present time. Doctor Alderson says, "David White, geologist of the U. S. G. S., testified recently before the Senate Public Lands committee, that within five years the United States Navy would have to depend upon foreign oil fields or oil shale for its oil."

Holding Work by Vacuum

Aluminum, brass, and other non-ferrous metal parts of small or frail construction are often machined under severe handicaps because of the difficulty of holding them. With thin aluminum castings the use of clamps may result in distorting them to such an extent that they will not pass inspection, while with small brass pieces, production rates may be low because of lack of adequate holding means makes it impossible to load the machine with more than a few parts at a time. When small parts are made of iron or steel, they can be conveniently held on a magnetic chuck for quantity production. To provide for holding large quantities of small pieces made of either ferrous or non-ferrous metals, and non-metallic work, such as rubber, fabric, wood, or glass, there has been developed a line of chucks that utilize vacuum for holding work.

In each of these vacuum chucks there is a chamber which is made air-tight when the work is placed over it, either by the work covering the entire surface or by other means. A vacuum is then created by pumping all of the air from the chamber, and as this is done, the work gradually becomes secured to the chuck by atmospheric pressure. One square inch of surface is capable of holding against gravity 14.7 pounds or of resisting a horizontal force of 470 pounds when a full vacuum has been obtained.

This method of holding by vacuum has been applied to drill presses, grinding machines, shapers and lathes used in the quantity production of small articles. An interesting application in lathe work is the vacuum chuck or arbor for holding the two halves of an automobile connecting rod bearing while machining the outside surfaces. With the possibility of many other applications, this unique method of holding should find widespread use in industry. —*Machinery.*

Cement Lined Cast Iron Pipe at Liverpool

A new cast iron water supply main from one of the storage reservoirs into the city of Liverpool, England, is being lined with what the "London Engineer" describes as "a strong cement mortar" applied by the special spinning process of the Stanton Ironworks Company. The main is 6.5 miles long, 42 inches in diameter for one-half of its length and 40 inches for the remaining portion.

"You've no kick coming," said the polite dispenser as he handed the customer a glass of near beer.

ATHLETICS

(Continued from page 106)

been placed there by the students. Loyalty for and love of Alma Mater have just as much a place at Armour Tech as they have at any university. Boys, let's get together and let them know that we have *school spirit* here!

One of the best ways to do it will be to support your baseball team!

Y.M.C.A. COLLEGE WINS WRESTLING MEET

The wrestling team opened the season by suffering a defeat at the hands of the Y.M.C.A. College. This meet was held on the floor of the latter named institution on the evening of February 15. The main trouble with the Armour team did not seem to be so much in lack of knowledge of the game as in lack of endurance. The fellows on the whole displayed the necessary fight during the first five minutes, but from then on seemed to be more or less worn out. Under the system of scoring used, which is the same as that used by the Big Ten, five points are given for a fall and two points for a decision. Thus, unless a man is able to stay on top of his opponent for at least the greater part of the ten minute period he loses whether he is pinned or not.

The best matches of the evening were those between Petersen of Armour and Baker of the "Y," Eisenberg of Armour and Wilson of the "Y," and McHenry of Armour and Santanen of the "Y." McHenry came through in good shape and scored the only fall for Armour. Eisenberg deserves credit for the snappy fight he put up in the beginning. With a little more experience he will make a valuable man. Petersen was matched with the "Y's" best wrestler and gave a good account of himself. The greater experience of his opponent finally prevailed, however, and he was pinned.

Armour was represented by McHenry, 115 lb.; Hogan, 125 lb.; Nissly, 135 lb.; Eisenberg, 145 lb.; Laederach, 158 lb.; Petersen, 175 lb., and Geymer, heavyweight.

The final score was Y.M.C.A., 22; Armour, 10.

FRATERNITIES

(Continued from page 107)

pledges being initiated were: G. Morgan, G. Verplanck, W. Kuffel, M. Kleist, W. Johnson, L. Burk and S. L. Chaney.

A number of the old boys dropped in on us during the past month, namely, Max May and Gerry Schumacher, our traveling magnates, the former coming in from Albuquerque, and the latter from "Noo Yawk." Allan Hill found time to get away from the chemical plant at Gary, Indiana, and attend the alumni smoker as did also L. Albee, our electrical wizard.

The boys having been rather active earlier in the semester have now settled down to devote all their time to scholastic gymnastics.

THETA XI

The annual meeting of the Omega Lambda Alumni Association was held at the chapter house on the evening of February 19. This being the first one since the purchase of our new house the reports of the various committees were eagerly awaited. These proved to be not only interesting but decidedly encouraging as well. In the election of officers, Brother H. A. Strain was elected president to succeed Brother E. R. Cole, while Brother F. L. Pond was re-elected treasurer. Among those present were Brothers Dierking, Shotwell, Coffeen, E. R. Cole, Strain, Pond, Matson, Holmes, Hayden, Stoker, Hupp, Ecklin, and Stryker.

The Sixtieth Annual Convention of Theta Xi was held in Indianapolis on February 22 and 23. This chapter, due to its central location, provided a very convenient meeting place for delegates both before and after the convention. Brother McCauley went as our official delegate. Brothers Senescall, Alber, Thoelecke and Johnson accompanied him.

PHI KAPPA SIGMA

The Alpha Epsilon Chapter of Phi Kappa Sigma is pleased to announce the initiation of the following men on February 2, 1924:

J. C. Bock
A. G. Brock
R. D. Fry
W. C. Miller

Owing to the death of Brother Homer H. Heuchling, the chapter has held no social functions. Several Alpha Epsilon men attended the Inter-Fraternity Banquet held at the Blackstone Hotel on February 7, 1924, and reported a very interesting and enjoyable affair. That Armour men are interested and active in the fraternity world at Chicago was evidenced by the fact that about twenty men of the four hundred odd in attendance were from Armour. The Armour "yell" was one of the features of the evening.

The programs of the Phi Kappa Sigma Club of Chicago have afforded the socially inclined an opportunity to entertain their friends. The men of the chapter are looking forward to Junior week and are much interested in the fate of the Junior Prom.

RHO DELTA RHO

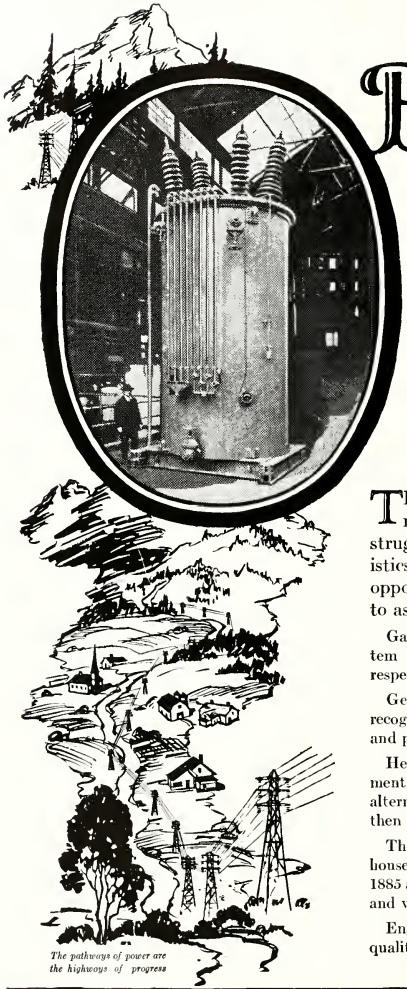
As the first semester is a milestone and a matter of history, the members of Rho Delta Rho started the second semester with a bang by having a Stag Party to send off Brother Applebaum who is leaving for Chile where he will take up railroad construction duties. We are sorry to lose our good friend, but are glad that success has crowned his efforts and expect great things from him in the future.

Now that we are in the midst of the new semester, we are starting preparations for the "Dad's Banquet" which will be held on March 15.

Several smokers have been held and helped to ease the grind a little. With our dance and the "Dad's Banquet" approaching, it seems as though studies must suffer, but we are determined to again take first honors.

UMEN

The Umen started the New Year with a grand banquet where the old Armour spirit was very much in evidence. Since that time it has been decided to have a social gathering once every month. A number of new members have joined the organization which is gaining in strength as time progresses.



Before Alternating Current Dominated the Electrical Industry

What Engineering Owes to the Far-Sightedness of George Westinghouse

THE impregnable position now occupied by alternating current was attained only after a bitter struggle, for, due to its supposedly deadly characteristics, practically the entire electrical fraternity once opposed the progress of what was generally referred to as "Westinghouse Current."

Gaulard and Gibbs originated the alternating current system in Europe. Their system was impractical in many respects, but had been used with some success for lighting.

George Westinghouse became interested, and immediately recognized that the weakness of their system lay in the design and principles governing the transformer.

He devoted the resources of his organization to the development of the transformer. When he made it a practical unit, alternating current, with its vast commercial advantages, then became possible.

The beginning of the bitter struggle by George Westinghouse for the supremacy of alternating current goes back to 1885 and 1886. Remarkable progress has been made since then and voltages as high as 220,000 are in commercial use today.

Engineering owes much to the far-sightedness and fighting qualities of George Westinghouse.

Westinghouse

ACHIEVEMENT & OPPORTUNITY

WESTINGHOUSE ELECTRIC

The Armour Engineer

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THE ARMOUR ENGINEER

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MY REMINISCENCES OF ARMOUR INSTITUTE

By

LEE DE FOREST

President, De Forest Phonofilms, Inc.

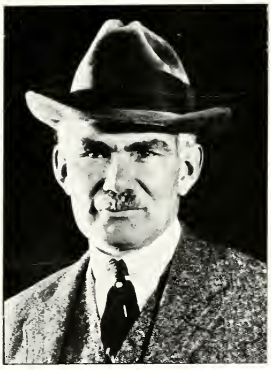
IT is with combined pleasure and reluctance that I attempt to push back the curtain of twenty-four years which have elapsed since I was working at Armour Institute. A pleasure to recall those old days of primitive beginnings and reluctance to realize all this happened so many years ago.

Early in the fall of 1900, while I was doing editorial work on the Western Electrician and attempting to carry out experiments in the then non-existent art of wireless telegraphy, I realized that I must, in order to get anywhere, have the facilities of an electrical laboratory. Perhaps my story will be better told if I quote excerpts here and there from my old diary of those days.

"Oct. 28th. I have begun to hazard my good place on the Western Electrician in working half time in the laboratory of Armour Institute and teaching two nights weekly at Lewis Institute. Shall I win or lose? At least it is not a life's work I am risking, and I am young and hardy and independent, and can yet again, put still further off the promised meed of good, in risk for better things—and eat more bitter *bittelbrod*.

"I am risking mediocrity and meek contentment for a chance of great success. Now it is up to me, and lies with me, I think—and it shall be success!"

I had during the preceding year a position in the telephone experimental laboratory of the Western Electric Company, which I had given up, as well as my position with an alleged wireless telegraph concern in Milwaukee, so that I could be more free to work along independent lines. So I moved down to the Armour Flats, bringing with me my good friend and grub-staker, E. H. Smythe and his brother. Smythe was keenly interested in the experimental work I was engaged



Dr. Lee De Forest, inventor of the Audion. He has perfected an attachment for the ordinary motion picture projection machine which converts light waves into sound waves, and renders possible talking motion pictures.

in, and his five dollars per week, plus a chance to discuss the day's work with him at night in our rooms, was mighty welcome.

The electrical faculty of the Institute gave me every practical facility in their power to enable me to carry on my experiments with the electrolytic detector and wireless receiving system on which I was at work. Particularly interested in my experiments was Professor Clarence Freeman, to whom I acted as laboratory assistant one day a week in payment for my tuition privileges. My experiments during that autumn of 1900 were none too encouraging, and reference to my diary shows that I fought a long and some times almost losing battle with fickle nature, physical and human. Yet the life had its bright moments. Once each week, usually Saturday night, we three would go down to the Studebaker to fill our souls with grand opera as given by the Castle Square Opera Company, at twenty-five cents per seat. This was my first acquaintance with opera and developed a love for it which has never slackened.

It is interesting to me now to note the keen enthusiasms which I then experienced, an element doubtless without which I should never have succeeded in my work. For example, I find this entry:

"Jan. 6th, 1901. The operas are ended and through all my thoughts and sleeping hours faint medleys run of songs half-formed, many winding echoes of the sumptuous hours of tone. Some I can recall, now when I desire; and again without thought or warning comes some phrase of treasured melodies which I have longed to know. And yet so many, alas, so very many, lie locked within the confines of my nether memory; and only a note or dim echo is ever borne to the sentient light where I may recognize them. Shadowy shapes of songs, unformed and wild, estray like errant breezes in the tangled woods of romance—an intervening vail of days detains them captive in that *traumen wald*, and tantalized I listen for their voice in vain."

I fear I was more prone to pen such ecstasies as this in my diary than succinct accounts of the experimental and scientific work upon which I was desperately engaged!

On February 10th I wrote:

"I am working now building a

reversing relay for the responder, and not being an expert machinist, meet delays and failures. I will have a sufficiently complicated and mystifying box of apparatus calculated to win capital from any miser! I am very happy in this work despite impatience and fears, for it is all my own, and great hopes grow with each completed part—this child of my brain and experiment.

"The Life is mostly the Work in this working world, and unless that Work be my own, my Life is not. How fortunate the few whose work is their life, who come from the day's toil almost regretfully to continue in other lines the same engaging study for the night, and can anticipate the morrow bravely, hopefully, to put in practice what is learned. Let that work be ennobling, that study broadening to the mind's horizon, the hope and outcome utility to man—and what truer joy has life to offer!"

March 2nd, 1901. I wrote to a friend: "This is a great life I lead—talk about your Yale Bohemia—it's not in it! Here one doesn't lose caste by leaving off his cuffs, or even wearing a collar for two consecutive weeks, and a shirt for twice that interval! If you go unshaved you simply pass for a 'single-taxer' and are given free range at the lunch counter!

"My pants are getting thinner each day and my coat smells loudly of fried potatoes from the 'Comet;' sometimes I have ten cents in hand, sometimes twice that sum. But hail gentle springtime! when I can don my New Haven golf pants, and hock my overcoat! I have three pairs of low shoes and calculate that by going barefoot about the house and standing up to save my trousers' seat, I can keep going until it is time to wear spring attire.

"I am a past-master of the art of economics.

"Behold the fruits of self-denial. I have just paid $30.79 on life insurance giving me the undisputed right to die at any time during the next 365 days, and next week I can and will pay $55 on my patent application."

But spring was coming, even that tardy spring of 1901: her awakening enthusiasm are evident in my diary.

Dr. De Forest is now recognized as a pioneer and leader in the field of wireless telegraphy and telephony. It is conceded that without his invention, the "Audion"—detector, oscillator, and amplifier—transcontinental wireless telephony would not be possible. He has taken out scores of patents in radio telephony and telegraphy. His name is a household word. His success is an accomplished fact. But at the time in which his diary was penned he was enduring all the hardships and confronting all the obstacles which fall to the lot of any young man starting upon his life-work.

This intensely human recountal of success attained by pluck and tenacity of will cannot but prove invigorating to the student who looks into the future and sees naught but stern toil.

On May 20th I wrote:

"Experiments on the 'Sponder' are now exceedingly encouraging, and I am happy. Indeed that vague and nebulous lustre which I have followed so long, so far away, has most radiantly brightened as I began to overtake it. Very pleasant seem the promised rewards of the unceasing toil, the unstinted self-denial, the forlorn hope so patiently pursued. And it is nearly time! The clothes are nearly tattered, the shoes run down, the meal ticket punched out!

"A few weeks more and the goal is mine—or lost. Let me not enthuse too early. 'Hope all things; expect nothing,' I have found my bitter axiom. Not yet have I laid my waiting hands upon the castle of my dreams, not yet."

So after months of patience the electrolytic detector was molded into such shape that it was deemed capable of public demonstration. For this purpose I rigged from the top of the flagpole on the west end of the Institute building a "bird-cage" antenna of lamp cord lashed to barrel hoops. As a sender I used the Institute's big Rhumkorf coil with a Wehnelt interrupter. With this transmitter keyed by Smythe we made our first "long range tests."

July 21st: "The first though shortest meant the most of all. For that decided whether our invention was good, or whether the months of toil, of discouragement, of doubts and anxious hoping had been all in vain, another treasure sunk in the vast depths of Lost Endeavor. So, as I stood in the rain on the top of the Lakota Hotel, at 30th and Michigan Ave., anxiously listing in the telephone receiver, throbbing heart beats pulsed the time till the sending key was pressed.

"I have heard glorious symphonies of Beethoven, the thrilling measures of Wagnerian music ringing through the soul, with all joy and inspiration; yet to my waiting ear did that faint 'whirr-whirr,' ticking the *hs* of the agreed signal, seem the sweetest music—the most enthralling sound heard by man!

"It spoke of a difficult goal now reached, it sang of great success, it seemed the whirr of spirit wings, perhaps bearing laurel! In the mystery of its transmission through that dark void, silent, invisible, timeless, I felt the presence of another world than I had known, the ether realm, to thought boundless, to the soul inspiring, to life Infinitude.

"Thus did I sleep that night, wearily, but well; and in my dreams the castles, shadowy yet far, seemed nearer to the morning hour.

"And once more I realized the wonder of the World Electric, where we work and theorize, as I stood on the four-mile crib—the faithful responder (keen little listener to etheric signals) by my side, and watched the yacht bearing the sender and some strange energy, become a speck upon the dim horizon, and then disappear. There was black coal aboard and fire, flying wheels, a few wires—and the unknown secret of Unity. Yet I heard the voice of that chemical potential translated through the heat and carried by the wires, and through the spark again

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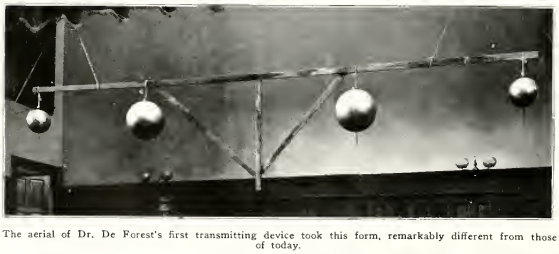

The aerial of Dr. De Forest's first transmitting device took this form, remarkably different from those of today.

ENGINEERING IN CHINA

By

R. L. LARSON, '08

Chief, Building Section, Anderson, Meyer & Co., Ltd.

THIS day (February 5, 1924) is the Chinese New Year day. On this occasion business is drawing what consolation it can from the thought that an unlucky cycle of years has just closed and is disposed, on the whole, to look forward with a certain or rather uncertain degree of optimism. General beliefs are all right, but business would be happier with more specific signs of prosperity to come. Still, the Chinese New Year is our foundation for hopes of better business and as engineering depends on business, we hope for more engineering activity in the coming year. This hope is based on the potential possibilities of a vast country, having an area more than twice, and a population about four times that of the United States; where the railway mileage is only about 6000 and the absence of highways and other modern engineering works is conspicuous.

The period from 1910 to 1920 promised a great impetus to engineering in the promotion of numerous railway projects, schemes for the improvement and control of waterways, construction of municipal electricity systems, waterworks and construction of textile, flour, oil and other mills. That period has however been followed by one of comparative stagnation.

The writer came to China in 1914 to serve as assistant engineer on designing and estimating bridges for the Szechuen-Hankow Railway, Ikwei Section. Surveys were then in progress for this line, which was proposed to be constructed between Hankow, Hupeh Province and Chengtu, Szechuen Province (a distance of 700 to 800 miles) from funds raised on the Hukuan Loan floated in America, France, England, and Germany. The German section extended from Hankow to Ichang, the American section from Ichang to Kweichow, the British, from Kweichow to Chungking and the French from Chungking to Chengtu. At the outbreak of the War, survey work on the German section ceased and preliminary work on the British and French sections was delegated to the American organization at Ichang. The survey from Ichang to Chengtu was completed early in 1915 and an estimate prepared, after which the American engineering force was disbanded. The writer was then appointed Professor of Railway and Bridge Engineering at the Chinese Government University, Peking. During two of the four years at that post he also served as structural engineer on the design, detail, and construction of the group of reinforced concrete hospital buildings of the Union Medical College, Peking, built by the China Medical Board of the Rockefeller Foundation. On the completion of this work and after a visit to America, he joined Anderson, Meyer & Co., Ltd., an American company engaged in the sale of engineering equipment and materials in China.

While relatively few Armour graduates practice their professions in foreign lands, here and there we find an alumnus who has strayed to distant shores. Since these men are more fortunate than their fellows, in that they come in contact with strange peoples and scenes about which we can only read, it is the intention of THE ARMOUR ENGINEER to present their stories whenever possible.

Mr. Larson gives a very vivid picture of the status of labor-saving devices in China, a status which is vastly different from that obtaining in America. He demonstrates the value of engineering works in terms of human life.

Although many may have been disposed to regard China as an untapped mine, needing only a store of technical knowledge for its working, a careful study of Mr. Larson's article will demonstrate that before technically trained Americans can accomplish great things in China the way must be paved by American investment and supervision of that investment.

As a marked contrast from the engineering activity prior to 1920, only a comparatively small amount of building construction in the large cities continued thereafter, except for the construction of about 2000 miles of highways from American Red Cross and other famine relief funds under American supervision, and the completion of a few other construction projects mostly started prior to 1920. This slump in engineering activity was due to the general trade depression following the War and also to the political situation in China.

The Chinese political situation may be summed up in the lack of a strong, effective central government. In the North, Manchuria Province is controlled by a military governor at Mukden, which at present maintains an armed truce with the central government after an attempted capture of Peking last year. In the South, Canton is the stronghold of an open rebellion against Peking. In the West, Chengtu is today reported to have been captured by the Northern (central government) troops "after a considerable amount of fighting in which the Chengtu Arsenal was shelled and destroyed," and less than a month ago, Shanghai, the center of foreign trade and influence in China, was apprehensive of civil war in its vicinity between the forces of the provinces of Kiangsu and Chekiang. This prevalent control of the various provinces of China by military forces striving only to defeat their opponents in order to extend their spoils system, hampers trade and progress. Capital and industry are insecure except in the cities governed and controlled by Europeans, and are subject to tax levies whenever the "war-lords" may be in need of funds. Banditry and brigandage are common throughout the country and the capture of Europeans and wealthy Chinese in the interior is a frequent occurrence, huge ransoms generally being demanded for their release.

As a notable result of conditions such as these, the foreign settlements at Hongkong, Shanghai, Hankow, Tientsin, and Dairen present a vastly different appearance from Chinese cities and even from the Chinese settlements contiguous to the foreign settlements. The foreign settlements have clean well-paved roads, efficient light, water and sanitary systems, and modern buildings. The Chinese cities generally have either the century-old, narrow thoroughfares paved with stone slabs covering inadequate drains which emit strong odors and in rainy weather overflow to cover the pavements with mud and filth, or else have cheap macadam pavements commonly in sad need of maintenance

and repairs, which in dry, windy weather give off "smoke screens" of dust and in wet weather require the use of "sea-going" boots. Shop and store buildings are usually two-story structures of flimsy brick walls, with round poles as joists for floors and roof, rough sawn floor boards and primitive clay-tile roofs. These buildings are usually open at the street front on the ground floor, without show windows or doors, so their wares and operations are plainly visible from the street, planks set into grooves and secured with batten bars being the means of closing up for the night. Residences, banks, and other more pretentious structures are one, two, or infrequently three stories high, of brick and wood construction. They are generally made up of a number of buildings with a series of courtyards and passageways, with brick walls eight to ten feet high surrounding them to keep out intruders. Electric lighting has been introduced to most cities, also waterworks to a limited extent and modern sanitation to a still more limited extent, but most installations of these kinds are operated with a surprising overload. On many 220 volt light circuits, for instance, 110 volt lamps are used during peak hours to obtain sufficient light.

As regards Chinese public works, ancient construction still comprises the only objects of much interest to engineers. The Great Wall, 1500 miles long and 20 to 50 feet high, with base 15 to 25 feet thick, extending from the sea and up over steep mountains at some places 4000 feet above sea level, has no parallel achievement here in recent works aside from the railways. Neither has the Grand Canal, that waterway 650 miles long on which excavation was commenced about twenty five centuries ago and completed in the thirteenth century, unless the continuous dyke building and attempted control of the Yellow River is considered. Enormous expenditure of labor in constructing dykes, masonry, embankments, and revetments has continued for centuries in the attempt to control the floods of this river, which at places has its river bed several feet above the level of the adjacent plains. One of these floods, some thirty-seven years ago, caused more than 1,000,000 people to perish by drowning or starvation, when a break in the dykes resulted in a flow 20 to 30 miles wide and 150 miles long to another river. Another flood in 1917 submerged almost 15,000 square miles and ruined crops to the estimated value of over $20,000,000, besides property to the value of more than this amount. Mr. John R. Freeman, past president A. S. C. E. during his stay in China in 1917 made a comprehensive study of this river as reported in the Transactions A. S. C. E., 1922.

In the foreign settlements, building construction increased remarkably after 1915 as a result of prosperity due to the War. Several dozen large reinforced concrete structures for textile, flour and oil mills, and warehouses were built in Shanghai. In most of these American machinery, reinforcement steel window sash, and roofing were used. At least a dozen modern office buildings have also been built here since 1915, the tallest of which is a nine-story reinforced concrete structure for the North China Daily News. As the structural design for this building was made by the writer and the reinforcing steel, metal lath, and so forth, supplied by Anderson, Meyer & Co., Ltd., a mention of outstanding features in the design and construction of such buildings in China may be of interest.

Architects of many nationalities are present here, the majority being British with several each of American, French, Belgian, German, Spanish, Japanese, and, of course, Chinese. Three or four Chinese architectural concerns, the principals of which have received their educations in Europe or America, have executed large building projects. Structural engineers here, are also of many nationalities, Americans being in the majority, aside from the Chinese, with British and Danish following in the order indicated. Chinese draftsman and assistant engineers are employed in practically all architectural and engineering concerns. Building rules and regulations in the International Settlement at Shanghai, as well as in the settlements of Hankow and Tientsin, and in Hongkong, are based on the London Building Acts. A few firms of European contractors are represented here and a local American firm was awarded the construction of the North China Daily News Building but failed before completing the job. Foreign contractors operate under the disadvantage of inability to bargain closely enough for Chinese labor and local materials such as cement, sand, stone, bricks, and lime. They are also under the handicap of greater overhead expense than Chinese contractors. It is therefore perhaps not amiss to state that the day of foreign contractors and construction personnel is practically finished in China. Numerous Chinese contractors have had sufficient experience to bid on the biggest jobs projected here, and while some of them have failed or suffered heavy losses, many of them have become wealthy during the recent building boom. These contractors are entrepreneurs to a greater extent than contractors in America, as they almost invariably sublet all labor as well as materials. In fact sub-contracting is extended to an astonishing degree here, small groups of workmen often being subcontractors (in the third or fourth degree) for certain portions of the work. Labor unions or guilds are organized in almost all trades but are not very militant. Working hours are commonly sunrise to sunset. Except rainy days, a few days off after the monthly pay day, and a week at Chinese New Year the Chinese workman knows no rest. The only strike heard of in several years resulted from a demand of the contractor's guild that "learn pidgins" should only be employed with their consent. "Learn-pidgins" are boys of six years and upwards apprenticed to the workmen for the ostensible purpose of learning their "pidgin" or trade.

As regards materials, sand, gravel, crushed stone, and lime are of course available. High-grade Portland cement is produced by several Chinese mills, a British mill at Hongkong, and a French mill at Haiphong. Japanese cement is also used and recently cement has been imported from Canada, Austria, Germany, and Sweden when freight rates and currency exchange were favorable. Gypsum, used to a very limited extent, has been imported from America and Europe, and a crude grade is produced locally. Bricks, except face bricks of special texture, are available in numerous sizes and grades, and hollow clay tiles are manufactured at Shanghai, Hankow and Tientsin. Wood is scarce and Oregon pine (Douglas fir) is generally used for structural purposes. China fir poles up to 8 in. by 20 ft. are available, but lumber is imported in large quantities from America, Japan, and Siberia. Japanese oak and ash, Singapore redwood, Burmese teak, and various Philippine and Australian woods are used for flooring, trim, and furniture. Steel in the forms of reinforcing bars and structural shapes is now imported, principally from Europe. Belgium and German products have recently supplanted American and British products because of lower price.

As regards construction equipment, Chinese labor evidently prefers its ancient tools and a very minimum of modern equipment and machinery. Bricks are laid with a trowel which most nearly resembles a small butchers' cleaver. When compelled to use an American trowel, the workman will lay it aside as soon as supervision is diverted. Saws for all uses generally consist of a narrow blade fitted into a wood frame of two end bows, with a center strut and a cord opposite the blade to regulate the tension. Concrete is usu-

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BUSINESS TRAINING FOR ENGINEERS

By
PAUL M. ATKINS
Of the Faculty, Dept. of Commerce and Administration, The University of Chicago

IT is a well-known fact that a large proportion of the graduates of schools of engineering are not becoming professional or resident engineers in the strict sense of the word, but that many of them are entering upon a business career of one kind or another. At Armour Institute of Technology, for example, over half the graduates of one of the courses enter business fields. In a recent issue of THE ARMOUR ENGINEER Mr. Gordon Wilson cited, among his classmates, one who had become a dealer in watches, another an onion farmer, while he himself was a banker. Does this mean that schools of engineering have failed to prepare their students for the work for which they are supposed to fit them, or are there an unusually large number of students in these schools who are misfits and should really have studied in some other type of school, or is there some other reason for this interesting phenomena?

It is hardly necessary to state that the calibre of the instruction in our better schools of engineering has been improving each year. There are unquestionably a considerable number of misfits in schools of engineering as there are also in other kinds of schools and colleges. There are too few misfits to account for the large number who do not follow engineering pursuits which are recognized as such, but who turn aside to become business men. The answer must be sought elsewhere, and to a considerable extent it may be found in the feeling that the engineer's training is an excellent basis for work in the business field. More and more it is being realized that where one man is needed to invent and design new equipment, there are dozens who are required to control its operation, sell it, finance its production and use, and so forth. It seems evident, therefore, that for some time at least, there is going to be a persistent demand for technically trained men in business. Part of this is undoubtedly due to the fact that the trained engineer has at hand knowledge which is extremely useful in coping with business problems, but more, perhaps, because engineering training develops the type of mind needed for solving business problems.

Along with this growing demand for engineers in the business world is coming the feeling that engineers who hope to make the greatest success in the business world must have some little acquaintance with the fundamental business principles and practices. This is evidenced by the establishment in the last ten years of programs of study in

Mr. Paul M. Atkins.

engineering schools called "industrial engineering", "engineering administration", and so forth, all of which are attempts to join to the fundamentals of engineering training, instruction in business principles and procedures. These curricula are still in a relatively undeveloped state, but that they are meeting an evident need is indicated by the large number of students who are enrolling in them.

A few years ago it would have been almost impossible to try to discuss what training in business an engineer should have, for the scope of what may be called the business field was unknown and the problems which are encountered therein unclassified. It is being more generally recognized at the present time, however, that business administration as a whole is divided up into certain large groups of activities which are frequently called functions. The functions overlap and interlock in various ways. Their coordination within a particular concern may be accomplished in sundry fashions. These various activities commonly include factory administration, marketing, finance, personnel administration, and record-keeping. Every man who claims to be trained for business should know something about each of them. In addition, to understanding thoroughly these business functions and the way in which they act, it is important to have some acquaintance with the physical environment which so frequently conditions business plans, that is, geography. It is also necessary to understand those social and economic surroundings which also serve to guide and limit the administration of business. These conditions are crystallized in the form of statutes and common law, and in social, economic, and business customs which are often just as effective as law.

In general, these are the subjects which should enter into the business training of an engineer. They are the ones which are being integrated into the courses mentioned above. There are engineering students who feel the necessity of more business training than such courses give, and there are others who have recently graduated or are about to graduate and who, therefore, cannot avail themselves of such opportunities and yet who want to learn something about business. For some of them, courses of the better and more reliable correspondence schools furnish a means of filling the gap in their training. Many men, however, are not in a position to take such courses. Others would really profit more by reading on their own account than by attempting to follow a prescribed course. With the rapidly increasing volume of business literature, it is becoming easier to read extensively in this field.

Before a man can read to advantage it is desirable to know at least a little of the kind of thing which should be read about, and to obtain some conception of the scope of the field which he is to cover. In the following paragraphs, therefore, the attempt is made to outline briefly the various functions of which a business is composed, and to suggest in passing some helpful books dealing with them.

Prior to the study of any subject it is helpful, whenever possible, to get some idea of its content. It is well, therefore, to survey, first of all, the en-

tire field of business administration[1] and gain some idea of the relationship existing among various functions within an individual concern.

The business function which is most closely related in most cases to those of the technical engineer is factory administration.[2] It is not a very long step from the design of equipment and the development of processes to the control of that equipment in the current production of saleable merchandise. Probably the majority of all factory executives who have had any college education at all are technically trained men. Within the scope of factory management come such problems as the determination of the proper kind of equipment—for there is all too frequently a difference between the technical and economic efficiency of machinery. A machine may approach very near to perfection from the designer's point of view, but be a miserable failure when it is looked at from the dollars-and-cents point of view of the user. It may well meet the needs of one situation and be quite inadequate to meet those of another. Closely allied to the problem of the choice of machinery is that of the selection of the building, the decision as to the kind of workers it is desirable to employ, the sort of materials to be used, the manufacturing standards to be set for each of these, and the methods by which the current control of production is to be exercised. The key to this last problem is found in what is commonly called "time and motion study."[3]

Once the means of production have been determined, it next becomes necessary to use them in order to produce the merchandise. It is essential to plan, schedule, and dispatch the work through the factory. Here questions touching upon the purchase of material[4] (a function which corresponds to the entire manufacturing problem in the case of a merchandising concern), the control of material, the actual operation of the manufacturing departments, the movement of material from production center to production center, its inspection, and often its shipment are encountered. The engineer will recognize the value of his technical training in dealing with most of these factory administrative problems.

In connection with factory management the engineer should give some attention to the application of the scientific or business method of manufacturing problems. As this movement was begun by F. W. Taylor[5] and Harrington Emerson,[6] and both of these men were largely interested in production, these methods were first applied in the field of shop administration. At the present time, the same approach is beginning to be made to the control of the other functions, especially in the field of marketing. Many of the principles have been developed in a generalized but not rigorously scientific form by Fletcher Durrell[7] in a book which should be of peculiar interest to engineers.

There is no use in making goods unless they can be sold, in the case of a manufacturing concern, or bought, in the case of a merchandising concern. The professional man is confronted with the same problem in a somewhat different form, for it is just as necessary for him to sell his services as it is for the merchant or manufacturer to sell his goods. Marketing,[8] then, is one of the fundamental functions with which every business man should be acquainted. It is much more closely related to the work of the engineer than might at first glance appear. The sale of many machines demands a very intimate knowledge of the products sold and of the benefits which the purchaser may gain from its use. In such cases, the sales manager and his assistants should have engineering training. It may be noted that in recent years the position of "sales engineer" is beginning to be recognized. It is essential to study carefully the actual and possible markets for goods and then to develop means of reaching these markets with the goods which are for sale, either actually or constructively. All this requires careful, analytical work for which the engineering training is excellent preparation.

One of the most important subdivisions of the marketing function is found in that which is devoted to reaching the customer by means of the printed word, namely advertising.[9] Here the engineer is needed whenever the article advertised requires technical description, just as sales of the same goods demand the services of the sales engineer.

There is scarcely any business which does not employ at least a few workers. As long as the concern is small enough so that its responsible head can know each and every employee, and is of the kind who can maintain his poise in dealing with them, there are not many personnel problems. As soon, however, as the company grows so large that this direct personal relationship can no longer exist, it becomes necessary to organize the relation[10] between the workers and the management in some definite fashion. Personnel problems are one of the most important groups with which the business man has to deal. It is especially desirable for engineers to study them, for most of their training has been in the handling of inanimate physical substance and forces, while, as a matter of fact, more difficulties are encountered in managing and directing individuals than in controlling physical forces and things.

This is a good place to call attention to the desirability for a knowledge of psychology on the part of the engineer as an aid in dealing with business problems. In its present form, this is one of the younger sciences, and lacks much of the definiteness which characterizes such older sciences as physics and chemistry. To a very considerable extent, however, it affects both personnel[11] and marketing[12] problems. The difficulties encountered in handling workers are largely due to a lack on the part of the management of the knowledge of their employes' mental processes. The key to sales and advertising problems is found in a knowledge of the way prospective customers think. An acquaintance with applied psychology is almost essential to the successful solution of

[1] There are no very satisfactory books which cover this entire field. One of the best for engineers is Dexter S. Kimball's "The Principles of Industrial Organization." (McGraw-Hill Book Co., Inc.) See also T. W. Shaw, "An Approach to Business Problems" (Harvard University Press), Edward D. Jones, "The Administration of Industrial Enterprises" (Longmans, Green & Co.), and C. W. Gerstenberg, "Principles of Business" (Prentice-Hall, Inc.).

[2] See Richard H. Lansburgh, "Industrial Management" (John Wiley & Sons, Inc.), C. W. Carpenter "Increasing Production, Decreasing Costs" (The Engineering Magazine Co.), G. S. Radford, "The Control of Quality in Manufacturing" (The Ronald Press Co.). For a brief yet more extensive bibliography on this general subject and on cost accounting see, Paul M. Atkins, "What Belongs on Your Bookshelf?" *Industrial Management* Magazine, March, 1923.

[3] See Wm. O. Lichtner, "Time Study and Job Analysis" (The Ronald Press Co.).

[4] See John C. Dinsmore, "Purchasing Principles and Practices" (Prentice-Hall, Inc.).

[5] See Frederick W. Taylor, "Principles of Scientific Management" and "Shop Management" (Harper Bros.).

[6] See Harrington Emerson, "The Twelve Principles of Efficiency" (The Engineering Magazine Co.).

[7] See Fletcher Durrell, "Fundamental Sources of Efficiency" (J. B. Lippincott Co.).

[8] See Fred E. Clark, "Principles of Marketing" (Macmillan Co.) and J. George Frederick, "Modern Salesmanagement" (D. Appleton & Co.).

[9] See S. Roland Hall, "Advertising Handbook" (McGraw-Hill Book Co., Inc.), and Paul T. Cherington, "Advertising, as a Business Force" (Doubleday, Page & Co.).

[10] See Tead and Metcalf, "Personnel Administration" (McGraw-Hill Book Co., Inc.).

[11] See Henry C. Link, "Employment Psychology" (Macmillian Co.).

[12] See Walter D. Scott, "Influencing Men in Business" (The Ronald Press Co.).

many of the problems in these two fields.

It has already been pointed out that mechanical and economic efficiency are not necessarily synonymous. The foot-pounds and dollars-and-cents measuring devices often give surprisingly different results when applied to the same question. It is perfectly astounding to many engineers to discover in how many ways money can be spent in connection with the operation of a business and in how few ways it can be brought into the business. Many new technical devices have never been presented to the public, and others have been delayed long years, because of inability to finance them. The best of production and sales schedules are sometimes upset because the capital which is needed to put them into effect cannot be obtained. It is highly important, therefore, for an engineer to familiarize himself with the various ways in which a business can secure the needed finances,[13] and the various institutions which are available to aid in this undertaking.

A Polish engineer has recently destroyed human beings as a "time-binding" element, because, unlike the animals, they carry over the experience of one generation to the next. In the modern business world, various methods have been developed for recording the results of transactions in such a way that the information may be most available and most useful as a guide to the selection of the right course in the future. Various records are already familiar to the engineer in the form of drawings of all sorts and kinds. Others are necessary as an integral part of the control of production and sales. There has been a more or less specialized type of record keeping developed over a long period of time which is called "accounting."[14] This system is designed to meet the needs of the business executive. A properly devised set of accounts should show him the financial standing of the concern at stated periods and the various steps by which the company has progressed from its position at the last stated period to its present place. These two important statements are called the "balance sheet" and the "statement of profit and loss." To supplement them various other accounting reports are prepared. The engineer should be familiar with these two principal reports and should understand their construction and the significance of the various items which appear thereon. In order to do this it is usually necessary to survey the means by which the information recorded in these reports may be collected in a systematic fashion. The devices customarily employed are accounts and journals in which the record of the original transactions are entered from the vouchers on which memoranda have been made. The type of system usually employed is called "double-entry" because two entries are made for every transaction. The engineer should be familiar with this fundamental concept of accounting for it should recall to him that well-known law that every action has an equal and opposite reaction occurring simultaneously.

A particular branch of accounting which is as closely related to the production control records as it is to the general accounts, and one which the engineer, because of his training, should be able to understand (although it is one of the most difficult branches of accounting) is known as "cost-accounting,"[15] or "factory cost-accounting." Essentially this kind of accounting is a record in terms of dollars and cents of what goes on in the factory.

Another and more general branch of record keeping which has been applied to business problems with increasing frequency in recent years is known as "statistics." In their simplest forms, statistics are comparatively easy to prepare and handle. It must not be forgotten that it is impossible to record complex transactions in simple ways. Hence it is not surprising that some statistics are rather hard to grasp. Their use is greatly facilitated if some form of graphical representation[16] is used so as to present important facts clearly.

The engineer needs an acquaintance with all of these different kinds of records. In studying them, however, he should devote more attention to their uses, both actual and possible. He should endeavor to understand the significance of the information which they contain in relation to the administration of the business. It is not necessary for him to make an extensive study of accounting technique. This is not only difficult but a knowledge of it is seldom essential to the adequate comprehension of the data recorded in the various accounts.

It is impossible to discuss, even briefly, all of the different business functions with which it is desirable to be familiar. Two others may be hastily mentioned in passing. One of them is an important aid to the transaction of business which is found in practically all companies, the management of the office.[17] The complexity of modern business requires the extensive use of correspondence. The proper preparation, reception, and adequate filing of correspondence, while not a matter of grave import, are details which can cause much trouble if neglected.

The other function is that of risk-bearing. There is scarcely any section of a business in whose operation some risk does not exist which must be borne in some way or another. In the boiler room the risk of explosion is reduced to the vanishing point by means of constant inspection. The risk of goods being returned after they are sold because of defects can be largely eliminated by careful inspection before they are shipped. The risk of fire can be cut to a minimum by taking proper precautions. In some of these cases the danger of any loss can be so reduced that any loss which may take place is negligible and can be borne by the business. Fire losses, when they do occur, are frequently so large as to be disastrous to a company unless it is protected by fire insurance.[18] Of all kinds of property insurance, that against loss by fire is the most important, but it is well for the engineer who is seeking a knowledge of business to know of the existence of the others at least.

So far only business functions of various kinds have been briefly outlined. These, and others which are of lesser importance or which can be grouped under one or another of the principal subjects discussed, make up a business concern. They should be coordinated and organized into a well-knit structure with efficient employes to take charge of each. The whole is greater than the sum of its parts in this instance, contrary to what the engineer has been taught in his own field. It should also be kept in mind when studying business problems that most of them are so inter-related that they cannot be solved without taking into consideration several different functions.

Important and interesting as the individual business is to the executive, it must not be forgotten that each concern operates in a world in which it is only one of many, and that its conduct depends largely on the surroundings,

[13]See Arthur S. Dewing, "Corporation Finance" (The Ronald Press Co.) and Harold J. Moulton, "Financial Organization of Society" (University of Chicago Press).

[14]See Wm. R. Basset, "Accounting as an Aid to Business Profits" (A. W. Shaw Co.) and Roy B. Kester, "Accounting—Theory and Practice" (The Ronald Press Co.).

[15]See Paul M. Atkins, "Industrial Cost Accounting for Executives" (McGraw-Hill Book Co., Inc.). This book contains both a general and an analytical bibliography of industrial cost accounting.

[16]See Karl Karsten, "Charts and Graphs" (Prentice-Hall, Inc.).

[17]See Lee Galloway, "Office Management" (The Ronald Press Co.) and S. Roland Hall "The Handbook of Business Correspondence" (McGraw-Hill Book Co., Inc.).

[18]See S. S. Haebner, "Property Insurance" (D. Appleton & Co.).

(Continued on page 153)

ALUNITE

A PROMISING SOURCE OF POTASH, REFRACTORIES, AND OTHER IMPORTANT HEAVY CHEMICALS

By
C. H. MacDOWELL
President, Armour Fertilizer Works

MANY a grey-head will remember the lump of rose alum stone mother used on cankerous tongues as an antidote for Blarney Stone worship on the part of the imaginative youngsters of the family. This rose alum, also known as Roman alum, a potash alum, was a family heirloom. It came from Italy, and was made from alunite, a rather rare mineral of volcanic origin found near Tolfa. This alum had been made there for centuries. It was also a product of Asia Minor in the dim days of long ago. The alum was useful for skin tanning and for fixing the Royal Purple dye. The rose color came from iron stain.

Alunite is a double salt of potassium sulphate and aluminum sulphate, almost insoluble in water. As found in Italy it is far from pure, containing some twenty-five to thirty per cent of silica, soda, and iron. The ore was roasted in heaps on wood fires, and weathered. The then soluble material was leached and the liquor evaporated to the point of crystallization.

In 1909 the writer was in Berlin in connection with celebrated "potash war" with the German government. A German merchant in London brought to our attention an alleged large deposit of alunite near Almeria in South Spain, from which he claimed potash could be obtained. Investigation proved the ore to be of thermal springs origin, shallow, impure—an aluminite containing little true alunite. Samples of the product were sent to the Armour Fertilizer Works laboratory and to Mr. Chappell, a chemist friend in New York, for research. Methods were devised for obtaining the potash. Nothing further was done, as the property was not a desirable one.

The German potash war was still being bitterly waged in 1910. President Taft had been asked to recommend appropriations for a potash search in the United States. These were made. In a talk with George Otis Smith of the Geological Survey, we told him alunite was a possible source of supply. He stated that the day before he had received notice of a deposit of alunite, which had been discovered near Marysvale, Utah. On returning to the hotel Mr. Chappell called up on long distance telephone and reported the receipt of some very pure samples of alunite from Marysvale, Utah. We repeated our conversation with Mr. Smith, and suggested that he go immediately to Utah. He did. The deposit looked promising.

Mr. C. H. MacDowell.

He obtained an option. Considerable development work was carried on. The property was purchased and further research on possible uses was started.

As already stated, the Italian deposit is decidedly impure, running about seventy per cent of the theoretical quantity possible. A large deposit in New South Wales, operated by English interests, has much rich alunite mixed with gangue. The Marysvale deposit is a geological freak as regards purity. The ore is massive, lying in a vertical fissure vein which averages twenty-one feet in width from wall to wall, in some places the vein is thirty-five feet wide. It runs about ninety-five per cent theoretically pure as mined. The outcrop, extending up a mountain slope, has been traced for four thousand feet at an elevation of 10,200 to 11,000 feet. The territory is volcanic; is on the Sevier fault. The section is highly mineralized: gold, silver, copper, and cinnabar are found near the property. The claims were first located for precious metals found in the walls, but no metal deposits of consequence have been found on the property.

In 1915 a company was formed to treat the ore for potash. Tunnels were driven in eighteen hundred feet. A mining depth of four hundred feet was attained and the ore body was persistent at this depth. Working conditions were favorable at this great depth.

An aerial conveyor was constructed down the mountainside to a good canyon road. The ore was hauled down hill from this point by wagon. The reduction plant was located some four miles below in the valley, about seven miles from the Denver and Rio Grande Railway at Marysvale. Here a village housing some four hundred people was constructed. A cement kiln was used to roast the ore with powdered coal for fuel. This drove off the sulphuric acid from the sulphate of alumina, leaving the potash soluble in water. This was leached, evaporated in vacuum pans, and crystallized. The product was an unusually pure sulphate of potash. The insoluble alumina was stored in a tailings pile. Although the method used was a rough and ready one, many thousands of tons of potash were produced during the war period. A considerable tonnage went into chemical manufacture. The German sulphate of potash, while of good quality, contained many impurities. When the German product became available at a low cost in 1921, the Marysvale plant was closed.

The research work done on alunite was quite exhaustive and decidedly interesting. The first problem to solve was the necessity for potash as a war emergency material. This meant the determination of those factors necessary for the proper calcination of the ore, the best means of lixiviation, of concentration, and of crystallization of the potash solutions. It was soon determined that over-calcination produces a substance which gives an alkaline solution on lixiviation, with considerable alumina in solution. Under-calcination

(Continued on page 153)

NOTES ON AUTOMOBILE BRAKES

PART 2

By
DANIEL ROESCH
Associate Professor of Gas Engineering

Types of Brakes

CONVENTIONAL Brakes: Automobile brakes have usually been of the external or internal band type, fitted to the two rear wheels or to the propeller shaft. These brakes have been quite satisfactory for level road conditions where the energy to be absorbed is much less than in the case of long, steep descents. For the latter condition, braking has been augmented by using the engine as a brake. The power necessary to crank an engine with the ignition off is about 10 to 20 per cent of the power which it can deliver. This power becomes available at relatively low car speeds because of the rear axle reduction, and selection by the driver of the further reduction of the transmission. The heat equivalent of the power absorbed is readily dissipated by this method, but other difficulties may develop. The maximum braking effect is obtained at high engine speeds and with low gears. The high speeds produce large inertia stresses in the engine, and considerable skill is required to shift to a lower gear after starting a descent. In making a shift with the conventional selective transmission the neutral or no braking effect position must be selected before the more powerful low gear engagement is made. If the latter cannot be engaged the time has been lost and probably the use of the less powerful higher gear engagement has also been lost. Further difficulties with engine braking may be the dilution of the lubricating oil-film on the cylinder walls when the ignition is off, and consequent mechanical troubles. It has been shown that the increased engine resistance after a few moments' use in this manner, is due to this condition. A further objection to engine braking is that bearing loads during the reversed power transmission, come at new and unconditioned surfaces, and may give abnormal wear.

Some of the developments of braking devices have been as follows:

Four-Wheel Brakes: A general increase in the use of the entire car weight for braking has been the recent trend. The means employed for operating these brakes have been chiefly manual, hydraulic, and air. To a lesser extent we find brake actuating forces obtained in a number of other ways.

Vacuum Brakes: The use of the suction in the intake manifold has been proposed as an actuating medium for brakes. Since the differential pressures available are lower than in the pressure systems, it is necessary to provide larger devices for equal pulls on the brake rods. The enlarged reservoir necessary for equal storage capacity is a disadvantage in the motor car. For direct action without reservoir reserve, the system depends upon the operation of the engine for braking —a condition not always present.

Electric Motor Actuated Brakes: It has been proposed to provide braking by electric motor actuated brake control cables. The motor is made reversible, and has its torque multiplied (about 400 to 1) by worm gearing. Breakage of the electrical circuit may automatically remove all braking ability without previous warning.

Electric or Magnetic Brakes: Directly applied electric or magnetic brakes may be used, preferably on the propeller shaft. The weight and bulk is a matter of importance, and demands the application to high speed shafts. The Entz transmission made use of the electric braking feature on the propeller shaft and therefore obtained inherent equalization at the two rear wheels.

Hydraulic-Transmission Brakes: Experimental cars fitted with hydraulic transmissions are usually designed to brake by hydraulic means. In one case the constant mesh transmission gears have been reported as being enclosed and used as an oil pump for braking. The power developed during descent of long grades is sufficient to overheat a considerable quantity of oil unless special provision is made for cooling.

Brake Actuating Means

The more extensively used means for actuating brakes have been as follows:

Manually Operated: These brakes are limited in the force available since the maximum pull on a hand lever is about 100 lb., and the push on a foot pedal 200 lb. Since the travel is limited, the force multiplication is limited. The leverage ratios commonly found on automobile trucks are given as (J. E. Schipper, S.A.E. *Transactions*, 1922).

Transmission brake 26-1

Figure 7.

This apparatus has been devised to measure the driver's reaction time, including his time of perception. When the test was applied to drivers who had been warned, so that their time of perception was practically zero, the reaction time was from 0.2 to 0.4 sec. when driving with foot on the brake, and from 0.4 to 0.6 sec. when driving with foot on the accelerator.

Foot brake, on two wheels.....20-1
Hand brake, on two wheels.....50-1
the efficiency of linkage for the above values being about 0.75.

Increasing the braking wheels from two to four necessitates a greater total

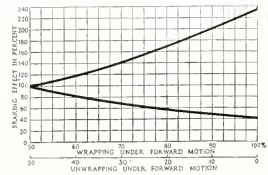


Figure 8.
Variations of braking effect with position of anchorage point.

force, if the maximum braking effects are to be realized. This is made available by "servo-mechanisms," which have assumed considerable favor.

"Servo-Mechanisms": The term "servo," when applied to brakes, covers those in which the manual braking effort is accentuated by a mechanism which obtains force from a moving part of the vehicle. It is in a sense a relay brake. It permits larger multiplication of actuating force without excessive travel of the brake pedal. Collective and individual servo-mechanisms are in use, and these may automatically effect brake release with stationary wheels, i.e., when skidding. In the Hallot type (*Automotive Industries*, Nov. 17, 1923, p. 964) centrifugal weights act on the brake drum. These give forces proportional to the square of the speed, and must be designed to automatically prevent locking from excessive centrifugal force. They have no holding power when the car is sta-

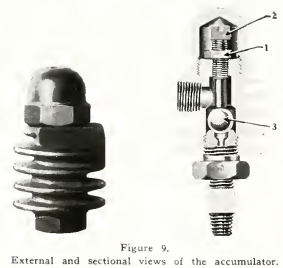


Figure 9.
External and sectional views of the accumulator.

tionary, and very little when descending grades at low speeds.

A collective type of servo-mechanism is used on the new (*Automotive Industries*, June 21 and Sept. 27, 1923; S.A.E. *Journal*, July, 1923, p. 57, and April, 1922, p. 283) Renault six cylinder cars and the Hispano Suiza. The foot pressure produces engagement of a disc clutch which is worm driven at a low speed from the tail shaft of the transmission. The driven plate of the clutch furnishes the force which applies the brakes to all four wheels. The friction of this clutch is practically independent of speed, and therefore produces approximately constant braking effort for given pedal and clutch conditions. It can be assumed that this clutch friction decreases rapidly when changing from a static to a moving condition, and then very gradually decreases with speed.

An individual type of servo-mechanism is used on the Serex brake (*Automotive Industries*, Dec. 13, 1923) in which the manual force presses a brake band against a wheel brake shoe. The latter tends to revolve with the wheel. A fork and lever connection from this brake shoe turns a cam which acts on the ends of the main internal brake shoes and expands them in the conventional way. One type of the Serex servo-mechanism provides a differential action so that the forward braking effect is more powerful than the reverse.

In the internal Perrot-Farman type (*Automotive Industries*, Nov. 22, 1923, p. 1051) automatic servo action is claimed, by use of shoes of different lengths. The longer shoe is anchored at one end and actuated at the other end through a floating pivot which connects it to one end of the shorter shoe. A cam operates the other end of the shorter shoe and presses it outward against the brake drum. The resultant friction between the shorter shoe and the brake drum increases the pressure of the longer shoe against the drum.

Self-wrapping of brakes produces a servo action which may be extremely powerful. This characteristic sometimes lacks uniformity, and can produce dangerous locking. When reversed, these brakes lose the self-wrapping feature, and require large forces for moderate braking.

When a band brake is anchored at one end and a pull applied at the other end, there is a wrapping or snubber effect which increases or decreases depending upon the direction of rotation of the drum. The effect of wrapping of a band brake has been studied by P. M. Heldt (*Automotive Industries*, Aug. 30, 1923, p. 426) who gives a chart (See Figure 8) in which the relative braking effect is shown for various percentages of wrapping and unwrapping. The chart shows 200 per cent relative braking effect with wrapping (anchorage at 90 per cent) and 50 per cent relative braking effect with unwrapping (anchorage 10 per cent).

A servo-mechanism patented by G. S. Wilkinson and the firm of D. Napier and Son, Ltd., uses a cylin-

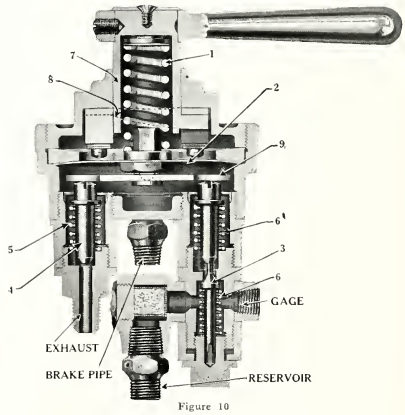


Figure 10
Sectional view of hand-operated control valve.

der and piston on each axle to actuate the brakes. The discharge of a gear pump operated from the rear axle passes through the cylinders back of the piston. By closing the discharge port in the cylinder by means of a valve actuated by the foot pedal, brake application is accomplished.

Lockheed Hydraulic Brakes: (Malcolm Loughhead, S.A.E. *Journal*, Oct., 1923, p. 313.) This type, which has found considerable favor, embodies a master hydraulic pump operated by a foot pedal. The pump pressure is transmitted to secondary cylinders and pistons which actuate the brake bands directly. The equalization of pressure gives each brake substantially equal

force on the band and, with equal conditions of the band and road surface, gives equal braking effect. The usual installation is on four wheel brakes, where the necessary precautions must be taken at the front wheels to avoid a braking force component from interfering with the steering forces. For best results, the wheel steering pin axis extended should come within $1\frac{1}{2}$ inch of the tire road contact. But when equalization is accomplished there should be no effect on the steering, although stresses may be imposed upon the steering linkages. When braking forces are unequal, due to variation in brake band or road contact conditions, the equalization of these forces no longer holds.

The return of the master piston uncovers a number of holes, 0.020 inch in diameter, which supply any necessary replenishment from a small reserve tank. The capacity of the system is about $1\frac{1}{2}$ pints of a mixture of equal parts of glycerine and alcohol. Provision against loss of liquid includes a cupped rawhide packing in the piston, and special 7-ply hose with a closely wound spring inserted in the bore. This hose is subject to a pressure of 1200 to 1400 lb. per sq. in. A toggle mechanism connected to the foot pedal gives rapid motion to the master piston at the beginning of the stroke, with about 55 lb. pedal pressure for 100 lb. per sq. in. hydraulic pressure. Only a slight increase in pedal pressure is claimed to be necessary to produce 500 lb. per sq. in. line pressure, due to the multiplication of leverages in the linkages. Mr. Loughhead's reports show that a 4400 lb. car (2000 lb. front, 2400 lb. rear) traveling at 30 m.p.hr., was stopped with rear wheel brakes in 89.2 feet, with front wheel brakes in 67.6 ft., and with both sets in 36.8 ft. These distances correspond to about 11, 14, and 25 ft. per sec. per sec. retardation, respectively.

Westinghouse Air Brakes: The Westinghouse Air Brake Company furnishes an automotive air brake equipment in which the brakes are set by compressed air, acting on long throw diaphragms, the latter being connected to the brake rods. The Fageol bus has been fitted with Westinghouse air brakes, the chambers of which are mounted directly on the rear axle. Other installations have the diaphragm chambers mounted on the chassis and connected to the brakes by proper links. These avoid the flexible tubing but introduce rod connections. The International bus uses a front axle diaphragm of 6 sq. in. area, mounted on the axle yoke. This operates the brake bands through wedges. The rear axle diaphragms have about 24 sq. in. of net area. Pedals which operate the air valves are sometimes also connected to the brakes by positive linkages.

The equipment includes: (1) A source of compressed air at a pressure of 30 lb. per sq. in. or more. This may be bled from one of the engine cylinders or taken from a separate rotary compressor driven from the transmission. When the engine bleed is used, an "accumulator" or specially cooled check valve is connected to the combustion chamber. (2) A storage reservoir, sometimes fitted with a safety valve. (3) Brake rods actuated by flexible diaphragms designed to give long strokes. The diaphragm chambers are made in sizes of 5, 7, and 9 inches outside diameter, and correspond to 6, 12, and 24 sq. in. of effective area. They are used in various combinations of sizes and brake rod leverages to give fair service braking with a minimum of 20 lb. per sq. in. air pressure. (4) A control valve, hand or foot operated, gives the desired brake chamber pressure, as indicated on a pressure gage. Various positions of the control lever automatically holds the air pressure to a definite value. Further movement of the valve increases or releases the braking pressure. Maximum pressure in the brake chambers may be adjusted at from 30 to 60 lb. per sq. in. (5) An application-release valve is provided for heavier vehicles to insure more rapid application and release. (6) For remote control of trailers, separate air reservoirs are provided. An emergency valve is used to give automatic brake application in case of rupture of the connecting air lines. Figures 9, 10, 11, 12, and 13, show respectively, the accumulator, control valve, brake chamber with diaphragm, application-release valve and emergency valve, of the Westinghouse equipment. These are described in the Westinghouse instruction pamphlet as follows:

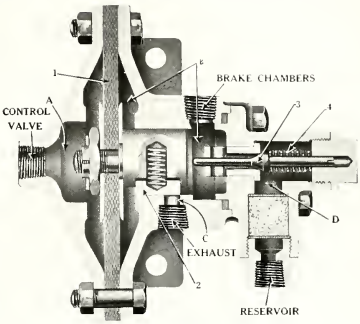


Figure 12.
The interior construction of the application-release valve.

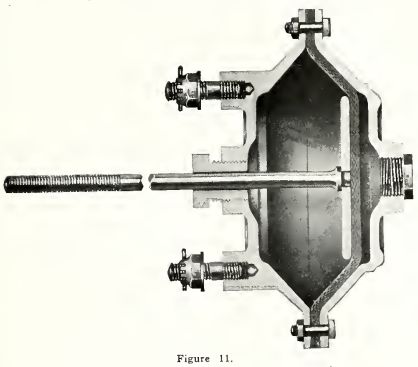


Figure 11.
Sectional view of brake chamber, with stud mounting.

The accumulator is a special form of check valve connecting to the engine cylinder. It is provided with heat radiating fins and adjustment for ball valve lift. ($\frac{1}{64}$ inch lift is recommended.)

The control valve contains a metal diaphragm (2), above which is a heavy regulating spring. Below the diaphragm is a cavity connected to the brake pipe and containing two valves: an intake valve (3) connecting with the intake pipe from the reservoir, and an exhaust valve (4) which connects to the atmosphere through the exhaust pipe. The exhaust valve is normally held open and the inlet valve held

closed by spring pressure. Moving the control valve lever for application pushes the spring (1) down—through action of cam surfaces (8)—and depressing the diaphragm (2), closes the exhaust valve and opens the inlet valve. This admits air from the reservoir to

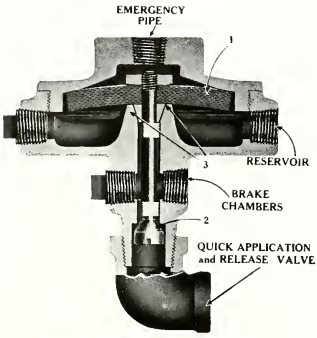


Figure 13.
A cross-sectional view of the emergency valve.

the brake pipe and when the pressure is enough to lift the diaphragm and compress the spring, the intake closes. The brake pressure is then balanced by the spring pressure which in turn is controlled by the position of the lever. A further movement of the lever compresses the spring still more and causes the balance to be established at a higher pressure; a movement of the lever toward release permits the diaphragm to lift and open the exhaust valve, releasing enough air to balance at a lower pressure. The brake pressure may be set or controlled as desired by control lever movement.

The brake chamber comprises two dished plates between which is a diaphragm made of two heavy layers of live oil-proof rubber, moulded with an inserted layer of fabric. One side of the brake chamber is connected to the brake pipe and the other side to brake rods.

The application-release valve is installed near the brake chambers and contains an oil-proof diaphragm (1) having an exhaust valve (2) attached to it. The chamber (A) connects to the brake pipe, while chamber (B) connects to the brake chambers. Inlet valve (3) connects with the intake pipe from the reservoir.

The diaphragm is normally in such a position that the exhaust port is opened slightly by valve (2). When air is admitted to the brake pipe by the control valve, the diaphragm (1) is deflected inward to close the exhaust valve and open the inlet valve, thus permitting air to flow from the reservoir to the brake chamber. The inlet valve closes when the brake chamber pressure builds up equal to that created in the brake pipe.

The emergency valve is installed on trucks and trailer installations and provides an automatic emergency feature. It consists of a metal valve (2) actuated by an oil-proof rubber disc (1). The chamber above the disc is connected to the emergency pipe, and that under the disc is connected to the reservoir. The bottom connection leads to the application-release valve and the side opening leads to the brake chamber.

The reservoir is charged from the emergency pipe past the rubber disc (1). During ordinary applications the control valve on the motor car operates the quick application and release valve as already described. Air then flows to the emergency valve via the bottom connection, past valve (2) and out the side connection to the brake chambers. Should the trailer break away from the motor car, the hose burst, etc., the sudden pressure reduction thus brought about in the emergency pipe will lower the pressure acting on top of the disc (1) so that the reservoir pressure acting under the disc will lift it and flow to the brake chambers, thus producing an emergency application of the trailer brakes. At the same time valve (2) is closed by the upward movement of the disc, thus cutting off the brake chamber from the quick application and release valve, which at this time has its exhaust port open. The elevated position of the disc also seals the port to the emergency pipe, so that the brakes are held in the applied position without leakage through the ruptured pipes.

Engine Braking with Modified Valve Timing

Maximum Power from Engine Brakes: The greatest resistance normally possible with engine braking will be obtained when complete air compressor action is obtained in each of the two revolutions of the cycle. Since the clearance space is large, the pressure pumped against is usually limited by the maximum compression of the engine, and this factor also limits the horsepower that can be absorbed. The large clearance space of the engine as compared to an air compressor reduces the air that can be handled, and hence the power. The work done in compressing adiabatically one cu. ft. of free air in an 80 lb. (gage) compression engine, would be 5180 ft. lb. This work of compression corresponds to about 35 lb. per sq. in. M.E.P., and may have added to it, say, 7 lb. per sq. in. M.E.P. due to a restricted intake. Combining the mechanical efficiency (0.75) with the above factors results in about 56 lb. per sq. in. M.E.P. net, from which the power to drive can be determined by substituting in the formula,

$$\text{B.h.p.} = \frac{\text{P (net)} \times \text{LAN}}{33{,}000}$$

Then B.h.p. to drive = 0.0001415 × displ. (cu. in.) × r.p.m. For a 400 cu. in. displacement engine this becomes about 59 horsepower at 1000 r.p.m., and represents the maximum available power under the assumed conditions. Practical consideration of valve timing will probably reduce this to one-half the given value.

It is to be noted that the speed will affect the filling and that other variables will influence the power at various speeds. The use of the engine brake in this way can be augmented by the transmission gears, and a given power absorption obtained at lower vehicle speeds.

Saurer Engine Brake: The Saurer truck, having been developed for Alpine work, naturally had considerable attention given to the durability and dependability of the braking system. The choice was in a special valve gear which caused the engine to function as an air compressor. Previous to this the Saurer truck was fitted with a fan brake attached to the propeller shaft. The present equipment (*Automotive Industries*, Dec. 27, 1923, p. 1315) is shown in Figure 14. After the engine throttle is closed, further movement of the throttle lever moves the cam shaft axially, and retards the cam shaft angle as much as 75 degrees of cam shaft angle. The engine is reported as delivering air from the exhaust to a closed inlet manifold and supplying it to other cylinders so that the compression reaches 100 to 140 lb. per sq. in. The indicator cards show negative work. The resultant "friction horsepower" has been computed for various engine speeds at from 50 to 150 degrees retard of the cam shaft angle (measured in crank shaft degrees), and the relative effectiveness of this engine brake under the assumed conditions is shown in Figure 15 in comparison with the conventional engine brake, with wide open and closed throttle. Curves are added showing the effect of temperature of jacket water upon the conventional engine friction.

Traffic Problems

It has been proposed to have three classes of streets—rapid transit streets, local streets, and traffic highways. (*Automotive Industries,* Nov. 22, 1923, p. 1077; Aug. 9, 1923, p. 296; Major E. S. Besson, Acting Engineering Commissioner of the District of Columbia, S.A.E. *Journal,* June, 1923.) The first class become business streets and are soon congested. The second class are residential, commercial, or industrial, and the third class are for through traffic. It seems desirable to add a fourth class of express routes for passenger transport in the case of large cities with interurban commuters. These should have special right of ways to fully develop the utility of the automobile passenger car and bus for distances exceeding 5 miles. Provision for entering or leaving the route should not be closer than one mile apart.

Brake Tests

Probably the best method of testing brake performance is by means of an accelerometer, with records of the speed changes. Such instruments are very convenient to use, and give the overall results of acceleration or deceleration. The device consists of a weight which is restrained by a spring or gravity, and proper levers and scales. The calibration may be in ft. per sec. per sec., m.p.hr. per sec., or in other desired units. Devices of this kind indicate grade directly, and automatically compensate for grade. They have been used for power determinations of cars which are accelerating. Power curves of the engine, friction losses, and braking ability, have been determined by means of the Wimperes recording type accelerometer. Power measurements require car velocity data in combination with that of acceleration or deceleration. An instrument of this type which has been used in the Automotive Laboratories of Armour Institute of Technology has been of considerable value in visualizing acceleration, and in determining road characteristics of vehicles.

When using this instrument for brake testing, the stopping distance can be determined with considerable accuracy. It has the advantage of showing in a very practical way the condition of the brakes of a car, regardless of the speed of the car.

If the accelerometer shows a negative indication of 8 ft. per sec. per sec. with two wheel brakes, the brakes are in good practical condition. Cars equipped with four wheel brakes should show a service condition permitting 15 ft. per sec. per sec. retardation. Careful study of this matter by W. S. James of the Bureau of Standards has resulted in the development of valuable instruments and methods, as presented in papers before the S.A.E. (S.A.E. *Journal,* Dec., 1923, p 499) and in articles in the technical press (*Automotive Industries,* Aug. 30, 1923, p. 412; Nov. 29, 1923, p. 1091). The Bureau of Standards instrument covers the range required by modern brakes, and has been used to take data which shows completely the desired information.

Braking tests on Brooklands track have been conducted by using a moving picture camera taking 16 views per second. (*Automotive Industries,* Dec. 13, 1923, p. 1215.) The views showed the position of the car in relation to white stakes and marks on the track at 10 meter intervals. The data give a distance-time relationship from which velocity and deceleration data are computed.

Braking tests described by Malcolm Loughhead in a paper before the Detroit section of the S.A.E., determined the point of brake application by means of a pistol fired into the road surface by the brake pedal movement. He reports errors of 6 to 10 feet when attempting to apply brakes as the car passes a given mark. This error is evidently a function of the initial car velocity.

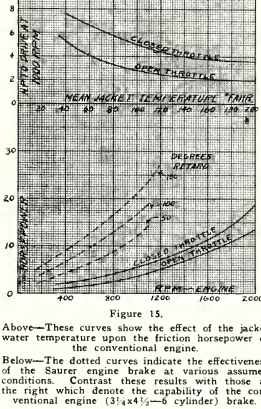


Figure 15.
Above—These curves show the effect of the jacket water temperature upon the friction horsepower of the conventional engine.
Below—The dotted curves indicate the effectiveness of the Saurer engine brake at various assumed conditions. Contrast these results with those at the right which denote the capability of the conventional engine (3¼x4½—6 cylinder) brake.

A series of brake tests on seven trucks were made in March, 1917, by the New York City Police Department and the Motor Truck Club of America. (*The Automobile,* March 29, 1917, p. 633.) These were made on a smooth asphalt street, and showed that the personal element was of considerable importance. The brakes were applied when the truck reached a chalk line on the road, and the distance required to stop recorded. It was suggested that the personal equation could be included in tests of this kind by having an officer on the seat give an emergency stop signal and simultaneously mark the road with a squirt of whitewash. It might be added that if the brake pedal action is arranged to give a second road mark, the driver's reaction time or distance could be measured. Acting upon this idea a device has been made by the writer and several students of Armour Institute of Technology which measures the driver's reaction time. This instrument is shown in Figure 7. In slowly moving vehicles the latter may become of more

(Continued on page 151)

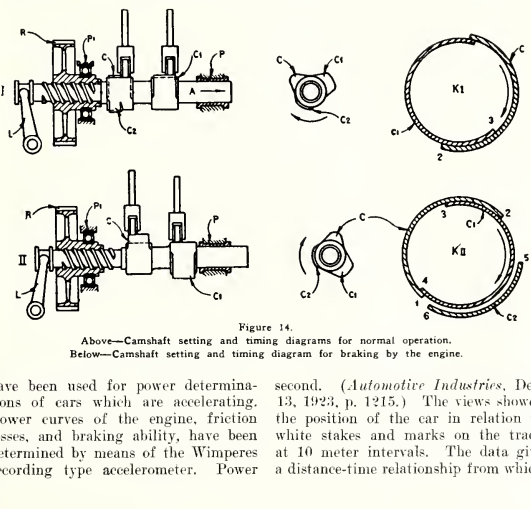


Figure 14.
Above—Camshaft setting and timing diagrams for normal operation.
Below—Camshaft setting and timing diagram for braking by the engine.

SPARKS FOR THE ENGINEER

By
RICHARD E. VERNOR
Manager, Fire Prevention Department, Western Actuarial Bureau

APPEALING to the general public for dynamic cooperation in the cause of caging the fire monster is usually a mixture of sentiment and science. The average layman is a creature of impulse. Complex displays of statistics are likely to register close to zero with him, but a mental picture of the blackened remains of a little child, locked in a house while mother went shopping, instantly creates a desire to prevent a recurrence of such a tragedy.

Proving to the average man that the fire waste is a serious drain upon his pay-check, and that it materially affects the high cost of living is also apt to stimulate his interest in the problem. When he concludes that the greater his contribution toward the national ash heap the less he will have to spend for clothes, automobiles, radio, food, and fuel, he is at least in a receptive mood for learning how to diminish this waste.

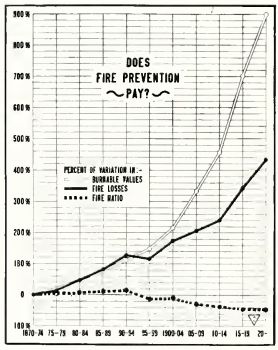
The engineer is popularly thought to be a cold, mechanical, and unsentimental sort of person. We do not ordinarily picture a great railroad builder as being interested in strumming the ukulele in the moonlight, and yet the engineer is quite likely to be as subject to reaction from the human appeal as any other normal person.

On the other hand, the engineer is a scientist, a seeker after truth, and before arriving at his conclusions, exhausts every avenue of debatable ground. Human he is, but added to the sentimental appeal he wants the facts before deciding upon his course of action.

The object of these lines is to convince the engineer that modern fire prevention is a necessary arm of his activity, that it is based upon sound reason because its practicability is already proven.

No small part of our annual fire waste is due to the defective designing and improper installation of heating, ventilating, and power equipments, and a considerable portion of the responsibility for the fire hazards existing in units of this character rests with the mechanical engineer, who obviously should be thoroughly familiar with all of the standards for safeguarding these devices.

There is no escape from the necessity for the electrical engineer being an ardent fire preventionist. He quickly learns of the danger of unskilled tampering with electric circuits, the perils of inadequate insulation, overloading, overfusing, and many other hazards of electricity; and yet an alarming number of fires are occurring daily from this agency alone. The electrical engineer must always be on the alert against fire.



This chart indicates clearly the relative decrease of fire losses compared to burnable values.

Even the civil engineer must be on his guard. Water supply and fire protection are inseparably intertwined in interest, for there must be no failure in water supply when a conflagration is threatened. Construction work of all classes is always in danger at the hands of careless workmen. A serious fire recently occurred in Duluth, during the erection of a reinforced concrete building. The loss was almost unbelievable but it could easily have been prevented. Even when the civil engineer is engaged in railroad construction the fire demon is watching his chance to start trouble.

The chemical engineer knows the disastrous consequences of mishandling his products; the danger of spontaneous ignition, the explosion possibility, as well as the menace of poisonous fumes, and the disregard of fire prevention rules may even cost him his life. The death of at least four [illegible] injury to ten others in a [illegible] torch accident furnishes a ti[illegible] onstration of the fact that [illegible] and be well known: A mixture of oil and oxygen under pressure is more dangerous than dynamite. In this instance an oil tank and burner were being used to heat a locomotive wheel tire in an emergency. There was no compressed air available to furnish pressure for the burner, so a cylinder of compressed oxygen was used as a substitute. The burner was lighted and at once the oil tank exploded.

Many altogether unnecessary additions to the cost of insurance protection have been made because of the failure of the architect to study structural standards, not only as regards the materials which he recommends, but such fire hazards in the building itself, which affect the spread of fire and the likelihood of damage from adjoining buildings. Failure to study the fundamentals of insurance rating is almost certain to bring grief upon the architect sooner or later.

So the engineer from a purely business point of view is really concerned with fire prevention as it is closely linked with his every day business.

Some of our illustrious ancestors had a theory that the earth was flat, others that the moon was made of cheese, and we still have our theorists who conclude that because the trend of our gross fire loss has been upward, all of our fire prevention effort has been for naught. Such a conclusion violates the laws of logic, for it is not warranted from the premise established.

The accompanying chart has an interesting story to tell, for it proves rather conclusively that fire prevention is no longer a theory, but is now a quite practical proposition. It should be observed that all figures are on a percentage basis.

The first line indicates the startling increase in our burnable values. Every year we as a nation make thousands of new products as well as increase our supply of the old ones. The data for fixing this line was taken from the *Statistical Abstract*, special information furnished by the United States Chamber of Commerce, and Babson's.

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CHARLES STEINMETZ

By

J. H. GOODMANSON, E. A. KLEIN, J. O. PECKHAM

E. E., '24

Who can take the place of Dr. Charles Steinmetz? What American has reached such world-wide fame and accomplishment? At the very mention of his name we experience a feeling of awe and reverence—a true indication of his greatness. Who in the electrical industry of the world has the experience and is blest with the versatility and charming personality that he possessed?

Charles P. Steinmetz, an unknown penniless immigrant became Dr. Charles P. Steinmetz, draftsman, electrician, inventor, philosopher, engineer, supertest man, mathematician, astronomer, naturalist, author, lecturer, educator, sociologist, and economist. Withal he remained unassuming, patient, and simple in his tastes. While he remained the kindly friend of the struggling, he attained rare intellectual heights reached by none in America, if not in the world.

Charles P. Steinmetz was born in Breslau, Germany, on April 9, 1865. He was the son of Carl Heinrich and Caroline (Neubert) Steinmetz. His paternal grandparents lived in Ostrowo, Poland; his grandfather Carl Steinmetz being a German and his grandmother a member of the Polish family of Gawenski. Carl Heinrich Steinmetz, one of their three sons, father of Dr. Charles P. Steinmetz, became a lithographer in Breslau. He married the widow of his oldest brother, Caroline Neubert Steinmetz. She had two daughters by her former marriage, and by her second marriage, a son, originally named Carl August Rudolf, but christened by the University Club to which he belonged, Carl (Charles) Proteus, a name which Dr. Steinmetz afterward adopted. The mother died during a cholera epidemic in the year 1866, and the children were cared for by their grandmother and an aunt from Poland.

At the age of four and a half years, Carl Steinmetz was sent to kindergarten, which he attended just one day, successfully protesting against returning to it. He thus portrayed his independence at a very early age. A year later he entered the elementary school where, strangely enough, in view of the fact that he later became one of the world's greatest mathematicians, one of his greatest difficulties was learning the multiplication tables. He subsequently attended the classical gymnasium, and in 1882 entered the University of Breslau. It was there that he was given the name "Proteus" by his college club, it being a custom of the organization to give each member a club name. When later he Americanized his name, he retained the appellation bestowed by the club and signed himself Charles P. Steinmetz.

J. O. Peckham

E. A. Klein

J. H. Goodmanson

It is significant that at this time there was a strong political tendency toward Socialism. While in the university he became interested in Socialism, against which vigorous measures were being taken by the government. Just before he was to receive his degree, an issue of a Socialistic paper which he was temporarily editing during the editor's imprisonment, and which contained several articles by Steinmetz, was confiscated. The publication was suspended. The editors and owners were arrested and held for trial. Although not much evidence against Steinmetz was found, the university authorities were requested to begin proceeding against him, a course they were slow to follow, as he was one of the most promising, well liked students.

Realizing that his career at the university and later as a professor was threatened by the attitude of the government, he decided to leave Germany. His name had already been included in the lists for arrest and trial. He therefore made a visit to a friend, a clergyman living near the Austrian border, and together they planned a means of escape.

With innocent looking return tickets in his pocket, he went to a picnic expedition across the border into Austria and thence proceeded to Zurich, Switzerland. There he made a scant living by writing and tutoring, while he studied at the Polytechnicum.

While at the Polytechnic School he became very friendly with a young American student, and when the latter was called home the two decided to share their fortunes. They, therefore, left for Havre, going by immigrant train, and took steerage passage for America. He arrived at New York, June 1889, penniless. He was able to speak but very little English. During the night preceding his arrival a wind blew on him through an open port of the ship which caused one side of his face to become badly swollen, so that the immigration officials hesitated to allow him to enter the country. He was sent to the detention pen, from which the eloquence of his friend, who showed a considerable sum of money which he said was their joint fund, released him.

Two weeks after landing, Steinmetz obtained employment as a draftsman in the manufacturing establishment of Rudolph Eickemeyer at Yonkers, N. Y. At that time the company was making a few electric motors and generators. It had just taken up work on the problems of the electric street car, jointly with Stephen D. Field. All the designs for the experiments with the electric cars passed through Steinmetz's hands. Quarters for a laboratory were obtained

and he began to specialize on magnetic testing. His writings on electrical subjects began to attract attention; his discussion of the law of hysteresis eliciting much interest on the part of electrical engineers.

In 1889 his first book was published, It dealt with astronomy and meteorology. In 1892 the General Electric Company bought the entire electrical manufacturing business of the Eickemeyer Company except the making of motors for elevators, which the Otis Company took over to its own plant. Steinmetz went to the Lynn works of the General Electric Company. In January 1893, he was transferred to the Schenectady Works and from that time made Schenectady his home. His title in the company was that of Chief Consulting Engineer.

He took his first naturalization papers out in Yonkers, and returned there in 1894, just five years after his arrival in the United States, to obtain his final citizenship papers. He cast his first vote in Schenectady in 1894.

As stated, Dr. Steinmetz had completed his work at the University of Breslau, but had to leave before receiving his degree. Harvard conferred the degree of Master of Arts on him in 1902, President Charles W. Eliot saying, "I confer this degree upon you as the foremost electrical engineer in the United States, and therefore in the world." In 1903 he was given the degree of Doctor of Philosophy by Union College. In the same year he became Professor of Electrical Engineering at Union and continued his connection with the college as Professor of Electrophysics. He was an honorary member of the Union College chapter of Phi Gamma Delta Fraternity, of the honorary scientific fraternity Sigma Xi, and of the engineering fraternities, Tau Beta Pi, and Eta Kappa Nu.

He was president of the American Institute of Electrical Engineers for the year 1901-2, of the Illuminating Engineering Society for the year 1915-16, and of the National Association of Corporation Schools in 1915. He served as Vice President of the International Association of Municipal Electricians for several years, was a Fellow of the American Association of Electrical Engineers and the American Association for the Advancement of Science, and a member of the British Institution of Electrical Engineers and the American Society of Mechanical Engineers.

In 1912 he was appointed president of the Board of Education of Schenectady. His loyalty to the Socialistic cause is shown in his politieal activities. In 1915 he was nominated to the Common Council of Schenectady on the Socialist ticket and was successfully elected. He was a Socialistic candidate for State Engineer and Surveyor in 1922, receiving a splendid vote, not enough, however, to elect him.

Books written by Dr. Steinmetz include the following: Theory and Calculation of Alternating Current Phenomena (1897, fifth edition 1916); Theoretical Elements of Electrical Engineering (1901, fourth edition 1915); Theory and Calculation of Transient Electric Phenomena and Oscillations (1909, third edition 1919); General Lectures on Electrical Engineering (1908, fifth edition 1917); Radiation, Light and Illumination (1909, second edition 1911); Engineering Mathematics (1911, third edition 1917); Electric Discharges, Waves and Impulses (1911); America and the New Epoch (1916); Theory and Calculation of Electric Circuits (1917); Theory and Calculation of Electrical Apparatus (1917). He also wrote numerous papers on mathematical and electrical engineering subjects.

He was one of the foremost authorities on electrical engineering and one of the greatest mathematicians. His special fields in the former were magnetics, symbolic method of alternating current calculations, and transient phenomena.

In the middle of October 1923, he was stricken by a fatal illness almost immediately after he had returned from a trip to the Pacific Coast, where he had attended the Pacific Coast Conference of the American Institute of Electrical Engineers, and delivered a paper on "High Voltage Insulation." Expert medical aid was summoned but to no avail. On the morning of October 26, 1923, Dr. Steinmetz died.

Perhaps the most effective way of describing Dr. Steinmetz, his work and the place that work holds in the scientific world is through the expression of appreciation by Dr. Frank B. Jewett, Past-President of the Institute, and by Thomas A. Edison.

> Dr. Jewett said, "In the death of Dr. Steinmetz, the electrical industry, not alone of the United States but of the world at large, loses one of its conspicuous and distinguished members. Surmounting physical afflictions which would have justified a quiet life, he brought to the support of a fertile brain and a vivid imagination, an almost incredible energy. For years he was a leader in the field of electrical research, particularly in matters pertaining to machine design and the transmission of energy, and his work in this direction has added much to our knowledge of the mathematical tools for solving complex electrical problems."

Thomas A. Edison said, "The world has lost one of its greatest practical mathematicians and the electrical industry will miss one of its shining lights."

Professor Harris J. Ryan, President of the American Institute of Electrical Engineers speaks of Dr. Steinmetz as follows: "Through life from early youth Dr. Charles Proteus Steinmetz was a profound student of the sciences, industries, linguistic arts and humanities. He worked constantly for their coordinate understanding in preparation for the solution of problems defined for progress. Through a decade he led the advance of electrical engineers to the modern understanding of the electric circuit, the transformer, induction motor, alternator and high-voltage phenomena. Dr. Steinmetz assisted his brother engineers to an untold degree, by his books, papers, and discussions; by his profoundly intelligent vision; and by his example of persistent, ably-directed enthusiasm."

We would like very much to be in a position to point out and elaborate on other than the physical facts of his life. We have obtained, however, from his biographers, men who were intimately acquainted with him, certain facts that show the very human side of his character. He is seen as a very prominent citizen of the city of Schenectady, taking a most important part in the civic problems, even to the extent of occupying public office. His interest in education took a material form in his acceptance of the presidency of the Board of Education. From this time he was continuously connected with this body in a more or less important capacity. We may wonder considerably how a man as busy as the late Dr. Steinmetz evidently was, could find time to devote himself to a purely philanthropic enterprise. One may be able to understand this, however, when he notes the indifferent manner in which he treated wealth. We know that he neither desired nor received any definite salary. Any money above that necessary for the more ordinary comforts of life (his tastes were moderate in the extreme) was considered by him unessential. He had a cabin in the woods, presumably for rest and recreation, but when we inquire of what his recreation consisted, we find he solved his most intricate and complex problems in this solitude.

His attitude toward riches makes evident a difference in ideas from the multitude, as regards theories of life. Although not a radical socialist, his ideas were very much in accord with the

(Continued on page 154)

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

We are pleased to announce at this time the formation of another local branch of the Armour Alumni Association. **Mr. F. P. Strauch,** in a recent letter to Doctor Raymond, tells of the founding of a branch at Kansas City, Missouri. Mr. Strauch writes in part as follows:—

We are pleased to inform you that we have a young but active Armour Alumni Association Branch at Kansas City, Missouri. The fifth luncheon was Friday noon, Feb. 8th, 1924, at our usual meeting place, the Kansas City Athletic Club.

We have 14 members, all we have been able to find in Kansas City to date, and we are now six weeks of age. The attendance is very good; on two occasions we have had ten members present out of a possible twelve. Two members are instructors in the schools here and they are not permitted to leave the school at the noon hour.

The names and titles of the members of the Kansas City Armour Institute of Technology Club are:

B. F. Eyer, '02, Manager, Fortified Mfg. Co.
B. Natkin, '05, Owner, Natkin Eng. Co.
L. B. Jones, '07, Mgr., United Warehouse Co.
H. Shepard, '07, Instructor, Manual Training High School.
A. H. Crocker, Jr., '10, Motor Cycle Agency.
Chas. E. Beck, '11, Dist. Mgr., Diesel Engine Co.
Frank A. Graham, '12, Industrial Eng., K. C. Power & Light Co.
Clarence L. Wetzel, '14, Inst., Lathrop School of Mech. Trades.
Sidney Pines, '16, Ass't. Mgr., Natkin Engrg. Co.
F. P. Strauch, '16, Dist. Mgr., Celite Products Co.
J. A. Keeth, '19, Ass't Supt. Prod., K. C. Light & Power Co.
H. A. Atherton, Chief Draftsman, K. C. Power & Light, N. E. Station.
Ellis C. Cook, '20, with Hettinger Bros. Mfg. Co.
Gilbert V. Bradbury, '22, with Bradbury Crusher Co.

We would be pleased to have you write us a letter to read at one of our Bi-Monthly Luncheons or, if possible, at our next luncheon, Feb. 8th, 1924.

Please inform us of Armour men that are in or near Kansas City so that we can get them to join our pleasant luncheons."

Rudolph J. Nedved, '21, is now in Europe, on the traveling scholarship given by the Chicago Architectural Club, which he won in competition last year. Mr. Nedved, accompanied by his wife, formerly Miss Elizabeth Kimball, who also was a student in the department of architecture of the Armour Institute of Technology, left this country last July and will visit England, France, Spain, and Italy, on an itinerary laid out by Professor Campbell of the Department of Architecture.

Mr. Nedved writes frequently to Professor Campbell, telling of the interesting places which he has visited, and his impressions of the people, their customs and habits, mode of life, and most important of all, their architecture. He is now in Spain and finds Madrid and the other larger cities very much like American cities. The railroads, however, he finds much inferior to ours; the tracks are very poor, apparently very little maintenance work of any kind being done on them. He finds living costs on the continent much cheaper than here or in England. In France or Belgium one can live fairly well for $2.70 per day; in Spain about $3.25 per day, while in England the cost is $4.40 for poorer living than one gets on the continent.

At least a year, and probably more, will be spent on this trip studying old world architecture. He is looking forward with great interest to Italy, where the student of architecture finds much to interest and inspire him.

J. Warren McCaffrey, '22, is with the Chicago Chemical Company, as sales engineer. Their chief product is sodium aluminate, which is an intermediate product in the manufacture of aluminum. It is used as a water softener, the aluminate serving to precipitate the scale-forming materials in the water. Those who know Mr. McCaffrey will not be surprised to learn that he is meeting with encouraging success as a salesman. His speech when Doctor Raymond was installed as president is remembered by many who are pleased to note that his gift of forceful and convincing speech is being put to practical commercial use.

W. Bissell, '22, is with the Illinois Steel Company at South Chicago. When he went there soon after graduation the only job open was that of vault keeper and he took it. Sometime later it became necessary for the mechanical engineer to have an assistant, and Bissell was given that job. He made good from the start, and when his chief left the employ of the company Bissell was the logical man for the place. So after less than two years he is mechanical engineer for the company and will no doubt go much farther.

A. E. Johnson, '23, is with the Westinghouse Electric Company, in the Chicago office. His company has recently expanded their facilities for maintenance and repair work, and Mr. Johnson is engaged in this branch of the firm's service. His work is largely that of a sales engineer, selling the service to owners and operators of electrical machinery which may be in need of overhaul or repair. Mr. Johnson reports a very good business along this line in the Chicago district.

From time to time it becomes our sad duty to chronicle the demise of an Armour alumnus. On February 27, 1924, **Federico J. Munoz** passed to his last resting place.

Mr. Munoz was a graduate of the Class of 1910 in the department of Civil Engineering. He spent several years in engineering work in the United States, returning to the Philippines in 1912. He there began a career of responsible engineering achievement. He constructed a number of Manila's finest bridges. He drafted the plans for the Angat water-supply and hydro-electric system project. Mr. Munoz was connected with the designing division of the public works bureau, Manila. He later occupied the position of assistant manager of the metropolitan water district.

For several years he was president of the Philippine Institute of Engineers.

(Continued on page 156)

THE VACUUM GAUGE

On the bulletin board there is a long typewritten list showing when and where the various final examinations for the year will be held. Students trying to crowd an entire semester's work into a few days anxiously scan the sheet, to find how much time is left for the cramming process. High pressure methods are needed now to overcome the vacuum which has been acquired throughout the term.

One man in the group before the board is almost a senior. He has been "almost" since the day he entered as a freshman, when he was behind in mathematics and mechanical drawing. He is now convinced that a conspiracy exists against him because the examinations in steam power plants and freshman chemistry are set for the same time in different buildings. He will see Professor Penn at once and insist that the hour for power plants be changed or that he be given a special examination in the subject.

Around the buildings there is a feeling of suppressed excitement, a tension in the atmosphere, a lull before the storm. Worried students thumbing texts and notebooks, sphinxlike professors preparing questions, bobbed stenographers cutting wax stencils, weary janitors moving innumerable chairs; zero hour machine design plates, overdue laboratory reports, ubiquitous yellowhacks.

Down in the mechanical department quite a group has collected around the large table in the hydraulic laboratory. One bright young man has been burning the midnight mazda going through the library files in the chapter-house of his fraternity. He has compiled voluminous data and plotted many curves (see March "Slipstick" for method used) and as a result of his original researches he is ready to announce some important discoveries. He finds that Professor Perry's famous question on the design of a flywheel for a high speed engine travels in a five year cycle and that it is due again this year. No group of astronomers preparing for the periodic return of a comet ever set to work more enthusiastically or to better purpose. A score of reception committees, self-appointed and of one member each, depart in haste to prepare for the return of the visitor.

To those of his audience who remain after the general exodus, the expert in deductive reasoning announces that Professor Freud's favorite question on the entropy change occurring during a change of state is now in its aphelion and need not be expected again for at least three years. There are profound sighs of relief from the chemists present; they have no taste for things astronomical, their entire knowledge of the subject being represented by Hg.

At 7:45 the next morning a gentlemen leaves the elevator on the fourth floor and walks toward the office of the department of mathematics. He is carrying a black brief case, not by the handle in the usual way, but clutched tightly under his arm. He lays the case on his desk, never taking his eyes from it as he hangs up overcoat and hat. Slightly under medium height, figure close-knit

(Continued on page 156)

COLLEGE NOTES

We are pleased to announce that Mr. Emil R. Zettler of the Architectural Department has been awarded the honors of the gold medal of the Chicago Society of Artists. Mr. Zettler has won high repute in his art, and indeed stands among the highest in the honor roll of Chicago sculptors. He exhibited several pieces—a portrait of Theodore Wagner, a Majolica figure, and a torso statuette in bronze—at the March award.

Professor J. C. Penn attended the 12th National Meeting of the American Association of Collegiate Registrars, held in Chicago, on April 2, 3, and 4. Professor Penn acted as chairman of the Committee on Registration and Introduction. Nearly one hundred and fifty institutions of learning sent their representatives to this convention. Although the freshman may sometimes think that he is the victim of unmerciful persecution by a stern, unrelenting faculty, nevertheless one of the papers read before the assembly was entitled "Can We Save More of Our Freshmen?"

Otto F. Cerney, '22, has recently won the LeBrun Traveling Scholarship. This is a National Traveling Scholarship entitling the winner to $1,400 to be used in traveling for a period of six months while studying architecture. Mr. Cerney was one of twenty-six competitors entered from the entire United States. The winning of the competition is no small achievement, and Mr. Cerney's drawings will receive widespread attention in architectural circles.

Another graduate of 1922, H. K. Bieg, is entered in the final competition for this year's Paris Prize. It will be recalled that Mr. Bieg placed second in the competition for the 16th Paris Prize.

Professor McCormack was in attendance at the annual convention of the American Institute of Chemical Engineers held in Washington, D. C., over the week of April 20. One of the chief features of the convention was the visit to the Edgeworth Arsenal, where the latest type of munitions of war were inspected.

108th ORDNANCE COMPANY CONSTRUCTS RANGE

For the last month the basement of the 33rd Division Headquarters Armory has resounded with the sound of steel striking steel. A modern pistol range is being constructed as rapidly as thirty enthusiastic men can put the pieces together. The range is built with a fifty foot range for small caliber rifle practice and forty-five foot range for pistol practice. The walls are protected by steel plates, and the target butt is constructed of six inch concrete slabs. The targets are of U. S. Army Regulation type mounted on runners which carry them back to the firing line for scoring. A battery of flood-lights illuminate the targets, eliminating shadows and highlights. The range was designed by Lieutenant W. R. Treff and Sergeant H. J. Luth. First and second cooks, J. H. Witte and M. T. Polk have been serving up eats and coffee to the men working on the range.

A trophy will be given to the man in the company who holds the highest score in three successive official matches on the range. There are a number of good shots in the company so the competition will be keen.

During the summer the company will make week-end trips to some of the rifle ranges north of Chicago at Camp Logan and Fort Sheridan, where the men will be given instructions in sharpshooting by some of the best riflemen in the army.

The company has lost several men since organizating due to disability and change of location. During the summer some of the Senior members who are graduating from college will be leaving the company. New men will be needed to fill their places. Any man desiring to join the organization can obtain full particulars from H. J. Luth at A. I. T. or from Lieutenant M. C. Adams at the 33rd Division Armory at 115 E. Ontario St., any Friday evening. The benefits derived from membership in such an organization are many. Any man who possibly can, should join the company and develop an efficient organization to help in the defense of our country when needed. This red-blooded group of men are all doing their bit to counteract the pacificist tendencies so prevalent. Will you help them?

THE JUNIOR FORMAL

The principal leading social event of the year was the Junior Prom which was held at the Blackstone Hotel on Saturday, May 10th. This was the second annual prom at Armour Institute, and according to all estimates has maintained the standard set by last year's Junior Class. The chief attraction of the evening was the Grand March which started at about ten o'clock and was led by W. Weinwurm, president of the Junior Class. The Club Chez Pierrians, with their stimulating strains, did their part to quicken the steps of the graceful dancers, who thoroughly appreciated the inherent genius in each of the syncopators. The success of the affair was due in great part to the efforts of the Social Committee, headed by E. S. Larson.

This refreshing event represents the next step toward making the Junior Prom a tradition at Armour Tech. It is now up to the classes of later years to continue the good work.

The Inter-Honorary Informal

Needless to say, we all enjoyed ourselves immensely at the inter-honorary dance given at the Hotel Ambassador last April 19 by Armour Tech's seven honorary fraternities. Our fair partners were peerless, and the music and the floor were all that could be desired. The general air of jollity which prevailed was much enhanced by the successful efforts of several of the boys to provide entertainment between dances. Larson and Chun, Eta Kappa Nu's own ukulele, guitar, and vocal experts, were heartily received, and Friedman, Tau Beta Pi's aspirant to Paderewski fame, was at his brilliant best.

We were glad to see so many of the alumni present on the floor, happy at every opportunity to aid the joining of alumni and undergraduates into a close-knit, firm unit in any one or all of the school's many organizations and activities. However, we are anxious to see more of the members of the faculty and administration present as we are always glad to have their co-operation and companionship in any of our undertakings.

The inter-honorary informal of 1924 is the fourth annual affair of its kind, and its growth tells of the rapid strides the honorary fraternities are making. The first dance in 1921 was put through by four of the five then existent societies, and the fourth annual of this year was sponsored by seven full-fledged and active fraternities, Phi Lambda Upsilon, Chi Epsilon, Eta Kappa Nu, Tau Beta Pi, Scarab, Salamander, and Sphinx.

SCHOLASTIC STANDINGS

The following statistics, compiled in the Office of the Dean give the scholastic standings of the members of the Freshman, Sophomore, Junior, and Senior Classes of the College of Engineering and Architecture, who were in attendance during the first semester of the school year 1923-24. In this computation the grades in Physical Training were omitted. A credit, either for work at the Armour Institute of Technology, or for work elsewhere was considered equivalent to a grade of "B".

The average of the entire school body, a total of 713 students is 85.6 per cent.

The averages of the various organizations are as follows:

The Senior Class	88.1
The Junior Class	86.7
The Sophomore Class	85.8
The Freshman Class	83.0

The student with the highest average in the Senior Class is Mr. John Henry Sweeney. His average is 95.2.

The student with the highest average in the Junior Class is Mr. Milton F. Adair. His average is 95.4.

The student with the highest average in the Sophomore Class is Mr. Arthur S. Hansen. His average is 96.3.

The student with the highest average in the Freshman Class is Mr. John V. Urban. His average is 95.0.

Mechanical Engineering Department	86.4
Electrical Engineering Department	85.6
Civil Engineering Department	85.3
Chemical Engineering Department	86.7
Fire Protection Engineering Department	85.7
Architectural Department	82.9

THE HONORARY FRATERNITIES

Tau Beta Pi	92.3
Scarab	85.7
Eta Kappa Nu	90.5

(Continued on page 157)

THE ARMOUR ENGINEER

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EDITORIALS

A FAREWELL AND A PROPHECY

It is with combined pleasure and regret that we take up the task of preparing our adieu to the readers of The Armour Engineer—of writing our last official contribution. The pleasure and elation is born of the knowledge of—

"Something accomplished, something done."

The regret is that which comes to the hearts of men when pleasant, memorable associations, of fellowship and effort are brought to a close just as they have begun to reach the fruitfulness of maturity.

The Armour Engineer has outgrown the stage where it can be published successfully by four or five men. An organization, and a large and effective one, well planned and well directed, is now indispensable to the proper conduct of the publication. And similarly the honor and credit for the success of a given year—as in the present year—is due this organization and its members rather than any few individuals.

But this organization alone could never produce a paramount technical college magazine. There must be something behind it—a student body united in interest. The Armour Engineer is the publication of, for, and by, the students and alumni of Armour Institute of Technology, and any value which it may acquire must be due entirely to their interest and backing. In the year which closes with the current issue, this interest and backing has been most manifest in the cooperation and contribution of the organizations and activities of our college: the fraternities, social and honorary; the clubs; and the engineering societies. To these The Armour Engineer owes most for its features of local interest.

For the immediate future we can predict with certainty that The Armour Engineer will continue to progress, much along the lines which have marked its advance in this and in the preceding year. The staff for the ensuing year is already organized and has undergone a period of training. The skeleton of a staff to take office two years hence is also in the process of organization and training. In this manner continuity of effort is assured.

The Armour Engineer enjoys natural advantages of location and environment equalled by no other engineering college publication. It is located in a large and growing city at the very heart of the industry, engineering achievement, and progress of the greatest country in the world. Its opportunities in a business way as well as its potential value in interest to its readers are very great. Thus far, in a manner of speaking, only the surface of these two factors has been scratched. The future, in the hands of the students and alumni of Armour Institute of Technology, will decide whether advantage will be taken of these wonderful opportunities.

The Staff.

In Memoriam

EDWARD DIEHL AGLE

Many former students will be grieved to learn of the death of Edward Diehl Agle, on April 9, 1924. Mr. Agle was seized by illness during the afternoon of that day, and, sinking rapidly, died the same evening.

Mr. Agle was born in Greencastle, Pennsylvania, on September 8, 1865. His early youth was spent in Greencastle and in Pittsburgh where he familiarized himself with the machinists' trade. He subsequently came to Plymouth, Indiana, where he was employed before his addition to the Armour Institute of Technology staff, which occurred in 1893. One of Mr. Agle's first tasks was the installation of the mechanical equipment necessary in shop training. Later he superintended the fitting up of Machinery Hall. Mr. Agle has given thirty-one years of service at Armour Institute of Technology, all of which have been in connection with shop practice. At the time of his death he occupied the position of Superintendent of Shops and Instructor in Machine Tool Work.

During the Great War, we extolled the bravery of the heroes in the front-line trenches; then we learned that the tireless devotion of the man behind the lines was just as essential in putting up a winning battle. And so it was with Mr. Agle: he performed his duties quietly, faithfully, and efficiently, doing much in a simple, unassuming manner to develop a sturdy character in the students under his direction.

We desire to offer our deepest sympathy and sincere condolences, on behalf of the students and The Armour Engineer, to Mrs. Marie K. Agle and relatives.

TO OUR CONTRIBUTORS

The closing of the year should be a time when debts are paid and obligations are cancelled. But we must here make acknowledgment of a debt and an account which cannot be settled, which our deepest gratitude and appreciation fall far short of repaying. To our contributors, who have made possible such an important part of The Armour Engineer, we can only say "Thank you!"

It is the attitude of a man for his work which spells success or failure. Someone said that the view of one's work was like that of the three stone cutters; when asked what their work was one replied that he was getting five dollars a day, another that he was cutting stone, the third that he was building a cathedral.

Sir Joseph John Thompson, an engineer by training and a physicist by profession, says:

"A large part of the success of an engineer depends upon his power of impressing and influencing the men with whom he is brought into contact. The education of the engineer ought then to be framed so as to develop those qualities which make him, in the highest sense of the word, a man with wide sympathies and interests."

ATHLETICS

O. M. Spaid, *Editor*

BASEBALL

Armour Tech's 1924 baseball season was opened by a game with Wisconsin. The student body turned out en masse to urge our team on to victory.

Our first few games serve to train and develop our new material. In the ranks of the new men we find Joey McLaren, who has shown enough good form already to warrant placing him among the stars. Joey can always be depended upon and we hope to see him knock a few more over the fence before the season closes. Samuels pitched good ball but had not sufficient training to go the limit. If he had perhaps there would have been a different story.

Pep is strong among members of the squad, a fact to be ascribed to the combined efforts of Coach Penn and our old standby Chuck Plocar. To see Chuck do his stuff behind the bat is reason enough in itself to cause the rest of the team to hit on all six. With such leadership Armour Tech is sure to win.

WRESTLING

The wrestling team has had two matches of late. Unfortunately both resulted in defeats although close scores were turned in for each event.

The first of these events was held at DePaul University and was combined with several boxing matches. The best match of the evening was between Eisenberg of Armour and Tiersky of DePaul. This match started in whirlwind shape and went into overtime periods, Eisenberg finally gaining the decision. Captain Geymer met an old opponent of his in the person of Griggsby of DePaul. This was Geymer's turn to lose evidently, as he had pinned Griggsby a short time before in a South Park meet. It might be here mentioned that DePaul's midget weighed in at 235 pounds while our own collection of thistle down couldn't register over 190 pounds.

The feature boxing match of the evening was between Cailles of Armour and Sweeney of DePaul. The DePaul man while nearly 15 pounds heavier than Cailles was fairly bewildered by the lightning attack of our speed champion and at the end of the match bore many visible signs of the conflict while Cailles was untouched.

The other two matches were between Gaffney of DePaul and Hamlet of Armour, and Malcolm of DePaul and McHenry of Armour. Mac having no opponent to work with on the mat decided to take on a boxing opponent. He performed very creditably indeed. The results of the wrestling match were DePaul 14, Armour 12.

On April 10, a return match was held with the "Y" College. Strange to relate the results of the meet were once more 12 to 14 in favor of the visitors. This was a good clean cut match all the way through and we are anxious to have another chance at their boys next year as such sportsmanship as their's is appreciated. The men turning in points for Armour were Captain Geymer, who gained a decision and Hogan, who won by a fall. A new man in the field is Price. He put up a very good struggle, although he lost the decision, he proved that he will be one of the powers of the team when he has had a little more experience.

TRACK

Although disappointed but not disheartened by the decision of the Athletic Association to send no team to the Penn. State Relay Carnival, the track team is working into shape for the spring meets. The one mile relay team that was sent to the Illinois Relay Carnival on March 1 placed fifth in the race which was won by Ohio Wesleyan in 3:31, almost three seconds faster than the previous track record. The time of Armour Tech was estimated at 3:32 2/5 which was also below the existing track record.

The outlook for the outdoor season is uncertain but should be considerably better than last year. In the dashes four men are making the hundred around 10 2/5, Hoff, Goers, Perry, and Spaid; and the 220 in the neighborhood of 24 3/5. The latter two of this quartet are also rounding into form in the hurdles. Owens and Long are running the quarter mile in very creditable time while Ball and Berry are doing good work in the half mile. The distances will be taken care of by Payne, Berry, and Robinson, the backbone of the cross country team. In the field events the material is still undetermined. Plocar can be counted on to come through in the shot putt whenever he is not piloting the base ball team, and Perry should place in the javelin. Alexander and Hamlet, both freshmen, are showing up in the javelin and discus respectively. By the end of the season they will probably have permanent berths. The broad jump, high jump, and pole vault are the weakest holes at present but it is hoped that some material will develop before the season is over.

The meets for this spring are:

April 26—Y.M.C.A. College at Y.M.C.A. College.

May 3—James Milliken University at Decatur.

May 10—Northwestern University at Naperville.

May 17—University of Chicago Invitation Meet at Stagg Field.

The meet on May 10 was originally intended as a Circus Day feature but since the date of Circus Day has been changed to May 9 the meet will be held at Naperville.

GOLF

The golf season is here again. Armour Tech golf team is all set to go, but aside from two matches and a school tournament they have very little to do. Matches are scheduled with DePaul University and Crane Tech. We have hopes for a few more but it seems that the smaller colleges in this section of the country do not take much interest in golf. Consequently there are very few possibilities for matches. Due to the Freshman Rule of Big Ten universities we can get no matches with them.

This year's team should be the best we have had for years for there are three freshman, Miller, Urban, and Schroeder, who, with the remnants of last year's team, Joseph, Nielley and Dunlap, should make an imposing team.

Golf is just coming into prominence as a collegiate sport. It requires the help and support of the students to keep it going. It is a game requiring as much skill and practice to attain perfection as any other played at Armour and therefore deserves as much attention as any of the major sports.

TENNIS

The following is the schedule for the Tennis Team for the Spring Season of 1924:

April	24	Crane College at Crane,
May	3	Northwestern College at Naperville,
May	6	Crane College at Armour,
May	9	Wheaton College at Wheaton,
May	14	Lake Forest at Armour,
May	16	Wheaton College at Armour,
May	21	Lake Forest at Lake Forest,
May	23	Northwestern College at Armour,
May	28	Marquette University at Milwaukee.

At the call for candidates for the tennis team, fifteen aspirants made their appearance in the gym, where they practiced several times a week previous to the coming of the tennis courts. The prospects for this year's team are very good; out of the fifteen candidates seven or eight good players can be chosen. The difficulty will be to pick the best four.

The courts are now in condition for play, and the Athletic Association has promised us a grounds-keeper to keep them in condition.

Here's to a successful season!

SWIMMING

On April 2 the swimming team held its first meet at Loyola University. The score was 32 to 26 in favor of Loyola with the relay deciding the meet. When the starter announced the last event, the relay, the score stood 26 to 27. Loyola won the relay giving them five points, and the meet. Brown, our diver, was only six points from his opponent with a score of 97 to 103. DeBourge was first in the plunge with 60 feet in 32 seconds. Captain Marhoefer took first in the 100 yard free style.

The team has two more meets scheduled:

April 25—Y.M.C.A. College at Bartlett Gymnasium.

April 30—Lake Forest College at Bartlett Gymnasium.

Freshman Logic

Prof.—"How much does a six pound shell weigh?"

Frosh—"I don't know."

Prof.—"Well what time does the twelve o'clock train leave?"

Frosh—"Twelve o'clock."

Prof.—"Then what is the weight of the six pound shell?"

Frosh—"Twelve pounds."

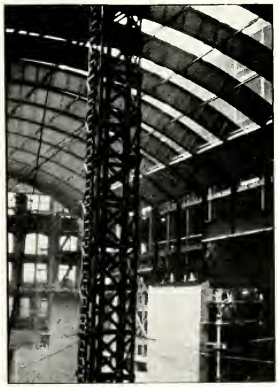
—*Juggler.*

ABSTRACTS

The New Union Station Project

While all Chicago goes on its busy way, unheeding, the beautiful new Union Station, one of Chicago's fondest dreams and a symbol of the "Greater Chicago," is rapidly rising to completion. The steel work of the main head-house is in up to the roof and the masonry and marble work are not far behind. The old, weather beaten, red terminal building which has served Chicago for over four decades is a striking contrast to its magnificent successor of Bedford stone and marble.

The entire terminal, which will be completed early in 1925, stretches from Roosevelt Road on the south to Lake Street on the north and lies between Canal Street and the river, including terminal trackage and lead-ins. The head-house or main station building occupies the entire square block bounded by Canal, Jackson, Clinton and Adams Streets, and will take the form of an eight story office building of the most modern type. The offices form a hollow rectangle, in the center of which is the immense rotunda or main waiting room. This room will reveal to strangers the grandeur of Chicago and its work, for it will be an enormous, vaulted and marble-walled lobby approximately 220 by 100 feet in floor extent, and the crest of its arched, tile-and-glass ceiling will reach to the seventh floor of the building, about 115 feet above the street. An idea of the vast size of the enclosure may be formed from the fact that the entire Machinery Hall of Armour Institute may be housed



An interior view of the waiting room of the new Union Station. The vaulted roof is composed of built-up arch beams connected with a grillwork of steel that will be inlaid with hollow tile roofing.

in it with the Assembly Hall thrown in on top of it for good measure. The room represents a great sacrifice of valuable space to architectural beauty, inasmuch, as one of the engineers of the project cannily points out, it is nearly all waste space from the point of view of passenger capacity and train service. The vaulted roof of the waiting room is composed of built-up arch beams connected with a grillwork of steel that will be inlaid with hollow tile roofing. Large skylights are to be built in at frequent intervals so that, as viewed from below, the room will be virtually open to the heavens. In order to relieve the tile and glass from severe stresses during the bitterness of winter, the entire roof will be shrouded with a network of steam pipes for heating it and preserving it at an even temperature.

Future needs have been carefully considered in planning the Union Station. The stubs of the columns which will permit future expansion can be clearly seen. The pent houses in construction on the roof will contain water-pumping and elevator equipment.

Although the present structure will be limited to eight stories, the foundation is ample for a twenty-story building and the steel columns project somewhat above the present roof so that the steelwork for the future addition, if such is desired, may be easily attached to them. The ceiling of the eighth story, which is to be the future ninth floor, is being covered in the meanwhile with a temporary tar and gravel roofing. The engineers have endeavored to strike hardpan or hard rock for their foundation footings and nave gone down with concrete footings and shoes as far as sixty-five and seventy feet below city datum, the average elevation of Canal Street being about 14 feet above city datum.

The office building itself will be ready for use in May, 1924, and will embody all the modern developments of architectural practice in this field. Where electrical conduits are run through the floors, they are imbedded in cinder fill concrete, and steam and water lines are enclosed with asbestos and tar-paper. For the telephone lines, in accordance with the latest practice, wooden conduits or raceways are run across the floor every four or five feet and all are connected to a main large runway which goes the length of the building. The raceways are firmly secured to the floor beams by copper clad steel clips. Wires may be fished through them before or after the top flooring is laid. Thus, no matter where a desk is placed, a telephone is brought to it by bringing a tap out of the floor no further than three or four feet away. Electrical power will be purchased from the local service company as alternating current at twelve thousand volts and will be transformed to voltages for lighting and elevator operation by large high tension transformers in the basement. Proper air circulation through the building is assured by large galvanized iron air-ducts, some of them as much as six feet square. These extend at frequent intervals from basement to roof, with suitable outlets.

The main section of the terminal tracks will be covered by a large concourse of a design similar to that of the head-house directly east, between Canal Street and the river. Foundation footings for this structure are to be about six feet in diameter and are now in the process of pouring. The entire train shed will be glass enclosed and will have the usual arched roof with locomotive smoke-jacks. The concourse and head-house are to be connected by a subway under Canal Street which will handle the entire passenger flow. The trackage is arranged in double stub-end fashion; fourteen tracks to the south, each capable of handling eighteen cars and a locomotive, are for the use of the Burlington, Chicago and Alton, and Pennsylvania roads; and ten tracks of similar capacity leading north are for the Chicago, Milwaukee and St. Paul, and Pennsylvania railroads. For convenience in car interchange, the two sections are tied in by three through tracks east of the loading tracks. One of these latter is already in use for present car movements. Load-in tracks rest on creosoted oak blocks over reinforced concrete slabs. Tracks in the shed rest directly on the concrete as train movements in this region are very slow. Track drainage is provided for, but subsoil drainage is not, as the sub-grade is somewhat close to river level. The subsoil is supported by a heavy retaining wall along the river bank.

Part of the permanent trackage on the south end is in use under temporary train sheds. The railroads on the north end are still using the old station, while the steam shovel men are energetically clearing the space between for the new train shed and concourse.

The new station will probably have a capacity of over three-quarters of a million people daily and there is no doubt that it will be ample to serve four busy railroads of the world's greatest railroad center for many, many years to come. If, however, Chicago is to have a population of fifty million in fifty years, as some engineers estimate, no man can say what demands may be made upon her gateways of transportation. The users of the great Union station at St. Louis were confronted with the necessity and the extremely difficult problem of enlarging it immediately after its completion. The new Chicago terminal trackage, hemmed in on one side by the river and on the other by a magnificent head-house costing millions of dollars, may prove difficult of enlargement if the traffic in years to come demands expansion of its facilities. In the dim future the great terminal may be deposed by a newer and greater edifice as it is now deposing the battered old landmark of forty years' service which was once the pride of its owners. Nevertheless, for the purposes of the present generation, the new terminal will stand before strangers as one of the first prideful achievements of a "Greater Chicago."

HIGHWAY DEVELOPMENTS IN ILLINOIS

By M. J. Fleming, '14

District Engineer, Division of Highways

Only a few years ago, Illinois ranked twenty-third among the states in regards to roads, and is now rated among the first. Before a state can proceed with road construction on a large scale, it must have the necessary legislation. Up to 1906 the township or road district was the unit. With such a small unit, however, it was not possible to work out a satisfactory system of highways to serve county, state, or national traffic. In 1906, the first Highway Commission of Illinois came into existence. This commission was given an appropriation of $25,000.00. This amount, at the present time, is nearly equal to the cost of one mile of our standard eighteen foot concrete pavement. All that the commission could do was to start an educational campaign for better highways. The next step in the line of legislation was the writing of the State Aid law on the statute books in 1913. This law provided for a certain mileage in each county which might be designated as State Aid roads, and could be improved jointly by the state and county. It was found, under this act, that roads were built in various parts of the different counties, but, as a general rule, did not connect principal centers of population.

The next step was the Sixty Million Dollar Bond Issue Act. This act was approved by a popular vote at the November election of 1918. It provided for approximately 4700 mile of improved highways which joined all the principal centers of population. The system comprises about five per cent of the total mileage of the state. The Bond Issue is financed by the funds raised from license fees on motor vehicles and not one cent is raised by direct taxation on either personal, or real estate property. The State Legislature next passed an act providing for a state-wide system of highways. This act might also be known as a Maintenance Act. The state, which is the largest unit, is given the necessary authority to take over the incomplete roads on the Sixty Million Dollar Bond Issue system, and maintain them, as well as take over and maintain detours around construction. All State Aid roads which have not been improved jointly by the state and county, or under paragraph 15-D of the Road Law, are turned over to the county for maintenance. All roads not included in the Sixty Million Dollar Bond Issue or State Aid system, remain under the control of the Township or Road District. It was the intention in this act, to give the state, the maintenance of those roads which carry the greatest traffic; the county, the maintenance of the important county roads, which are next in the amount of traffic carried; and the township, the roads which carry the least amount of traffic.

At the last session of the Legislature, there was approved a bill known as the One Hundred Million Dollar Bond Issue Bill, which will be voted upon at the general election in November of this year. This bill provides for the improving of approximately five thousand miles, in addition to the mileage included in the Sixty Million Dollar Issue System.

During the construction season of 1922, there were built 722 miles of pavement. During the construction season of 1923, there were built 1077 miles of pavement. Of the 1077 miles there were built 859 miles on the Sixty Million Dollar Bond Issue System, and 218 miles on the State Aid System. The latter is under the direct supervision of the Division of Highways, but financed with county funds. During the last season, there were built as high as fifty-five miles of pavement in one week, which reduces approximately to one mile of pavement an hour for the working day. There exists at the present time, about 2425 miles of pavement completed on the Sixty Million Dollar Bond Issue System, and nearly 800 miles of new contracts in force.

A few years ago, the state built what is known as the Bates Experimental Road, which originally consisted of sixty-three different types of pavement. Later five additional types were added. This experimental road was about two miles in length. All materials entering into the construction of the various types of sections were carefully inspected and all information was carefully recorded. The various sections of pavement were studied for some time, before controlled traffic was permitted to use it. The first load which the Division used, was trucks from which the bodies had been removed, and the weight was increased until a maximum of 13,000 lbs. per wheel was reached. Failure occurred in many of the types during the latter increments of loads, but that portion of the road which was built according to the present standard (nine inches at the edges, thinning to six inches, two feet from the edges, and then uniform six inches between these points), came through without a break.

Nearly all materials entering into the construction of these roads are inspected by the Division of Highway's representatives located at the plants of the material producers. Occasionally a car arrives at the unloading point which has not been tested, and in this event, samples are taken and tests made before the materials are used. All matters pertaining to construction are closely watched, as inspectors are maintained at the central mixing or proportioning plants, and at the point where the concrete is being poured.

In order to put over a program of this size, it is necessary to store part of the materials during the winter months. The contracts provide for one-third of the cement requirements, to be placed in storage before May 1 of that construction season. It quite often happens that the contractors are asked to store more than their one-third requirements, and in this case, they are generally allowed fifteen cents per barrel. In a great many cases, contractors begin stock piling of sand and stone, in the spring, before soil conditions are such that they can begin their paving operations. Railroad shipments, as a general rule, can not be depended upon to keep a paver operating uniformly.

Recently, the Department of Public Works and Buildings decided upon the policy of traffic service. This policy includes the marking of the routes throughout the entire state, and the maintaining of incompleted routes and detours around construction.

As soon as construction is completed, maintenance begins. The Patrol System is used. The patrol sections on concrete pavements have a length of from fifteen to twenty miles and by the system it is possible for the patrolman to do most of the labor without hiring additional help.

Recently, figures submitted by the Bureau of Public Roads indicate that a substantial reduction is made in operating costs on improved roads as compared to unimproved roads. From this standpoint, money is not being spent for roads, but is being invested in them. The return to the motor vehicle operator in reduced operating costs in improved roads makes the further building of roads a necessity.

A Water-cooled X-Ray Tube

A new water-cooled, high voltage, X-Ray tube, developed by Dr. W. D. Coolidge of the General Electric research Laboratory, has received hearty medical endorsement, following a thorough trial in cancer treatment by Dr. James T. Case, a prominent X-Ray specialist of Battle Creek, Michigan. Dr. Case installed one of these tubes in the radiotherapy department of the Battle Creek Sanitarium in the summer of 1923, when a series of animal experiments was undertaken. Since the first of August, 1923, all the clinical material requiring treatment by Röentgen rays at that institution was handled with the new tube.

Radiation from X-Ray tubes has been used in cancer treatment for many years. For some time these tubes were of comparatively low output and their successful use was confined to the use of tumors not too deeply seated. The development of the original Coolidge tube gave the X-Ray specialist a much more powerful tube, and in 1921, Dr. Coolidge brought out a new design capable of operating at higher voltage, (200,000 volts maximum) which, because it gave radiations of shorter wave length and consequently greater penetration, was more adapted to treating deep-seated cancer. But even with this tube, with a power output of more than a kilowatt, the treatment for cancer was long and tedious, the patient

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SOCIETIES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The chief social event of the society for the present year was the Annual Smoker, held on April 30. All hands worked together in making the smoker one of the best in the history of the society.

A considerable amount of our time has been taken up during the semester with the presentation of illustrated lectures. Professor Gebhardt, chief of the Department of Mechanical Engineering at the beginning of the year had recommended to the society that the type of meetings most suitable to the development of the members would be those in which they would have the opportunity of addressing their co-workers: the wisdom of this recommendation has been amply demonstrated. The change has resulted in stimulating the interest of all connected with the society and has further brought to the fore some capable speakers.

The first of these illustrated lectures was presented to the society by E. A. Barrett. The subject was "Steam Railroad Electrification." At a later meeting A. H. Joseph gave a very instructive talk on the topic "Mechanical Stokers." Mr. Scribano, as official projector operator, is entitled to considerable credit for his help in this respect.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Although the society, under the direction of J. R. Brady, has held many worthwhile meetings, the most instructive was that of March 25 when we had the pleasure of hearing Professor W. D. Harkins of the University of Chicago. Professor Harkins presented "The Photography of Atomic Collisions." He is a pioneer in research along these lines and illustrated his lecture with slides and motion pictures obtained in his experimental work in the laboratory.

A joint meeting with the W. S. E. was held April 3. On this occasion we were addressed by Mr. M. A. Smith, director of education of the U. S. Gypsum Co. Mr. Smith an Armour alumnus, discussed "The Engineer in Business."

WESTERN SOCIETY OF ENGINEERS

The Armour Branch of the Western Society of Engineers has held six very good meetings, including a smoker.

The first of these was addressed by Mr. R. M. Thomas of the Reading Iron Co., who also showed four reels of "The Manufacture of Genuine Wrought Iron Pipe." The speaker at the next meeting was Mr. R. H. Ford, Assistant Chief Engineer of the C. R. I. & P. R. R. His subject was: "The Student and the Young Engineer, and Their Problems."

On March 21 the smoker was held in the rooms of the Western Society of Engineers in the Monadnock Building. At the next regular meeting we heard Mr. M. A. Smith of the U. S. Gypsum Co. speak on: "The Engineer in Business." He was very interesting, especially since there are several A. I. T. graduates working under his direction. The meeting of April 10 was concerned with asphaltic paving materials. The speaker was Mr. McClintock of the Warren Bros. Co. The last meeting, that of April 17, was addressed by Mr. Harry Taylor. His subject was: "A Business Talk Plan."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Since the last issue of THE ARMOUR ENGINEER we certainly have been keeping the ball rolling. Every meeting has been a live affair with some very interesting speakers. We are proud to say that a number of the talks were by our own members and showed that our intent in learning the correct way in which to address a group of men on an engineering subject has not been in vain.

Mr. Waver, who at one time was connected with the train lighting department of the Pullman Company, gave us a very good talk on "Railway Train Lighting and Its Problems." We were all more appreciative of this phase of lighting after having heard his address. On April 10 we went in joint session with the Armour Tech Radio Club to hear Mr. Flewelling speak on "Radiophone Reception." Mr. Flewelling is well versed in radio circles. He is the inventor of a receiving circuit that bears his name.

As this is the last issue of THE ARMOUR ENGINEER for this school year, the American Institute of Electrical Engineers wishes to take this opportunity to thank those who through their untiring efforts have made this year a most successful one for us.

ARMOUR FIRE PROTECTION ENGINEERING SOCIETY

The past two months have been very energetic ones for the society. In addition to having the pleasure of listening to several interesting speakers, a smoker, the second this year, was held. There have been a great many smokers put on at the Institute in the history of the school but never such a one as this. All previous smokers have bowed their heads in shame after the one held at the Phi Kappa Sigma house on April 10.

The Fire Protect clan assembled shortly after eight o'clock and the first event on the program was a hair raising film depicting the hazards present in every home. These ranged from smoking in bed to giving the children toys filled with nitroglycerine. After the audience had sufficiently recovered and recombed their hair, Mr. Brown made several mortifying disclosures. In the first place he extracted a one pint flat bottle filled with an amber colored fluid from the right rear pocket of the head of our department. Mr. Parker seemed very much interested in the contents of the bottle and stayed near Professor Finnegan the rest of the evening. Perhaps the other disclosures made by Mr. Brown had better remain untold.

As if this were not enough to shatter the ideals of the freshmen an officer of the law appeared shortly afterwards and served warrants on Mr. Nelson, Mr. Matson, Mr. Parker, and Mr. Robinson. The charge was somewhat smothered in legal phraseology and many of us do not know yet what crime the above named gentlemen had committed. It must have been quite serious though because they were required to sing "Sweet Rosy O'Grady" as a penalty. This quartet was not all that it might have been owing to the fact that the only one of the singers knowing the words was Mr. Nelson. The quartet was so vigorously applauded that the society quartet summoned sufficient courage to present several numbers. As a closing number they presented an original master to the strain of the "Armour Y. M. c. A." The words more than made up for any lack of music. The faculty and prominent members of the Fire Protect Department were duly commemorated in song and story.

Next the long-looked-for "shingles" were brought forth and presented. They are the pride of every man in the Society. We are deeply indebted to Mr. Townley for the wonderful illustrated lettering and also to Mr. Parker who presented the copies of the original to the members of the Society.

Last, but not least, came the long-looked-for refreshments. Cider, sandwiches, doughnuts, etc., filled a great vacancy and the party adjourned after one of the best smokers ever given. Our only regret was that some of the other departments were not present to see what a real smoker looked like. Messrs. Waterman and Cooper were the gentlemen behind the scenes and we are deeply indebted to them for a wonderful evening.

The society wishes to take this opportunity to welcome Mr. Townley and Mr. Parker as the honorary members of the Engineering Society of the best* department at the Institute.

**Editor's Note: We must make due allowance for the Fire Protects' optimism in this respect.*

ARMOUR TECH MUSICAL CLUB

The members of these organizations believe that the past year has been one of the most successful that the Musical Clubs have known. This belief is substantiated by a reference to the large number of engagements which the clubs have had. These entertainments were, for the most part, held at churches and club meetings.

At the Inter-collegiate Glee Club Competitive Concert our Glee Club proved that it ranks with any from the large midwest colleges. That the Glee Club has improved in technique and presence is indicated by our increase in scoring points in various details of last year's competition.

Our Orchestra and Band were in excellent condition for the Annual Home Concert given in the Mission on the evenings of April 23 and 24. They gave the Glee Club some keen competition.

We will lose Douglas, the director of the Band, through graduation. A lot of credit is due "Doug" as he is the organizer of the Band and has made it the success that it is. We have also enjoyed

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FRATERNITIES

TAU BETA PI

Since the last appearance of THE ARMOUR ENGINEER, Beta of Illinois chapter, Tau Beta Pi, has been enjoying a quiet but busy time. Every member is interested in at least one of the school's many activities, and the individual efforts of each has been felt perhaps more than the combined effort of the fraternity as a whole. The great majority of the brothers have been spending their last days at Armour Tech, and doing their utmost to make every minute count.

In the annual spring election from the upper one-eighth of the Junior Class, the following men representing five departments were pledged.

S. A. BAIRD
HERBERT H. CHUN
H. J. LUTH
A. K. MILLER
E. M. MYER
H. W. REGENSBURGER
A. L. STEMWEDEL
S. R. WILLEY

After serving a rigorous pledgeship in which they convinced the active members that they possessed the required qualifications of personality, loyalty, and character, they were formally initiated to membership on Tuesday evening, April 22, at a meeting held in the Tau Beta Pi rooms. These men, together with brother M. F. Adair, who was initiated as high junior in the fall of 1923, will serve as a nucleus for the furtherance of Tau Beta Pi in the coming year. The graduating brothers feel assured that with them as leaders, the true spirit of the fraternity will be carried undaunted into the future.

During the semester Tau Beta Pi turned its attention with the other honorary fraternities to the fostering of an Inter-Honorary Fraternity Dance. Feeling for such an affair had run high for some time, and finally with the combined efforts of all of the honorary fraternities the dream became a reality. The dance, which was an informal affair, was held at the Ambassador Hotel on the evening of Saturday, April 19. The program was featured by entertainment furnished by pledges, as well as dancing. The general attendance of both students and alumni, together with the fellowship and spirit shown, makes every member of Tau Beta Pi look forward with eagerness to the announcement of another Inter-Honorary Fraternity Dance.

ETA KAPPA NU

Eta Kappa Nu has received many excellent papers submitted by sophomore electrical students for its prize contest. While no announcement of the winner can be made at this time, the results of the contest are being awaited with eager interest.

The spring candidates for Eta Kappa Nu have been elected and initiated into our brotherhood. They are all Juniors, elected on basis of scholarship and character. The men so chosen are:

J. R. FREDERICK
C. E. LARKIN
E. S. LARSON
J. H. SCHROEDER
W. H. SOTHEN

These men served to entertain us right royally at the banquet held on the evening of April 12, before the Chicago, Milwaukee, and Fort Wayne Alumni Chapters.

PHI LAMBDA UPSILON

Omicron chapter of Phi Lambda Upsilon brings to a close one of its most successful years. Our membership has been increased to eleven by the addition of the following men:

T. BOCKMAN
I. A. DEUTCH
R. E. DUFOUR
E. H. HANSON

These men have served a pledgeship which has been arduous, to say the least and have worked wonders with the chapter's rooms. In lieu of a May-day party, initiation was held on May 1, followed by a banquet at the University Club.

SPHINX

Sphinx announces the initiation on the evening of Thursday, May 1, of the following men:

SENIOR

E. L. NIEDERHOFER

JUNIORS

M. F. ADAIR
J. R. FREDERICK
W. J. MCCAULEY
C. G. MILLER
H. W. REGENSBURGER
L. C. SENESCALL

CHI EPSILON

Chi Epsilon's spring banquet was held at the Lakota Hotel on April 2, and was well attended by the active alumni members. Our pledges provided entertainment for the evening. The men initiated into Armour Chapter at this meeting were:

Honorary Member, PROFESSOR M. B. WELLS
E. L. GRITSCHE
R. L. LAWSON
S. R. WILLEY

PHI KAPPA SIGMA

Alpha Epsilon Chapter wishes to announce the pledging of the following men:

N. COTTINGTON
D. M. ROSS

The Chapter's first social event of this semester was an informal house dance held in March. Also, we had our Faculty Dinner and Smoker that month—over fifty of the faculty being present.

The second Fire Protect Smoker of the year was held at the house April 10. Mirza entertained the assemblage with some very mystifying tricks. A jazz orchestra and movies also helped to liven the evening.

Our semi-annual Alumni Smoker was given on April 26. Many of the old timers were with us again.

It is always our custom to give the graduating seniors a dinner dance which will be given in May. Also our annual spring picnic is to be held during the latter part of this month. This is always looked forward to as one of the best times of the year.

With all these events coming apace, the boys are finding plenty of time to spend on school work as the home stretch leading to the finals is now at hand.

DELTA TAU DELTA

The Thirty-eighth Annual Western Division Conference of Delta Tau Delta was held at the Congress Hotel, February 29 and March 1. The meeting was well attended and in consequence much important business was transacted.

"Doc" Wieland presided, as usual, in the capacity of toastmaster at the banquet. It was our privilege to entertain the delegates at a house-smoker, on Friday evening.

Delta Tau Delta wishes to announce the initiation of "twelve good men and true." The neophytes were introduced to the mysteries on Sunday, February 24.

Our annual Deli Prom was given at the Blackstone Hotel, February 15, and lasted till the wee sma' hours. Everyone agreed that it was the best party that they had ever attended. Our latest social event, the May 10 party was a great success, being graced by a number of our alumni brothers.

THETA XI

The Sixtieth Anniversary of the founding of Theta Xi was celebrated with fitting ceremony and merriment at the Chapter House on Saturday, April 26. The house was open all day and there was something doing every minute during the afternoon and evening—as any of the hundred and fifty men who signed the roll will vouchsafe. From 1875 to 1927 is a fair span of years but representatives of both college classes mingled together and forgot the gap that Time had tried to effect.

During recent weeks it has been our privilege to have as our guests Dr. H. M. Raymond and Mrs. Raymond, Dean L. C. Monin and Mrs. Monin, Dr. Sibley, Mr. E. B. Hatch, Mr. W. M. Krieger and an even greater than usual number of our older alumni. We also have the pleasure of looking forward to similar privileges in the next few weeks when we expect to entertain again Messrs. A. B. Pond and J. K. Pond of Pond and Pond, Architects, and Messrs. W. S. Foster and Egbert of the Insurance Co. of North America.

As sheepskin time rolls by again, we must drop from our active roll those unfortunates who are pushed out into the cold wu-r-r-l-d. Men of Theta Xi have heard that call and unless some by their efforts evade the issue, we must soon bid them Godspeed. Beckwith, Blaufuss, Brueckner, Cole, Farrell, Heller, Klein, Sisson, and Thoelecke will, according to all indications, be numbered among the missing next fall.

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NOTES ON AUTOMOBILE BRAKES

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importance than the braking ability of the car. On the other hand, at higher road speeds the reaction time means greater distances traveled before initial retardation and becomes of greater importance with higher decelerations.

Brake Lining Tests

Brake lining tests at the Bureau of Standards have been reported by Mr. S. von Ammon (S.A.E. *Journal*, March, 1922, p. 153) and show the variable factors met with in practice, and a commendable study in reducing a difficult problem to laboratory analysis. These tests included those of coefficient of friction, influence of water, oil, temperature, and wear, durability under different operating conditions, and methods of testing.

The coefficient of friction is greatly influenced by the character of the material, and test conditions of pressure, speed, duration of test, temperature, and brake surfaces. Values vary from a minimum of 0.11 to 0.25 during severe service where the impregnating compound acted as a lubricant, to a maximum of 0.75 for the most favorable conditions. Fair average values may be taken as from 0.35 to 0.50.

Tests to determine the absorption of oil and water showed the following results for the various types of linings.

Lining	Absorption, Oil	Per Cent. Water
Woven	14-30	10-27
Folded and rubberized	7-24	7-27
Molded	8-17	4-24

The above tests were made upon weighed samples 5 inches long, submerged in oil or water at 212 deg. F. for one hour.

Durability, as determined by dividing the thickness loss in inches by the time in minutes, and multiplying by a constant to obtain convenient figures, is termed a wear factor.

The scope of this preliminary work indicates the great variation of braking conditions met with in practice, and presents valuable charts and data.

Police Inspection and Regulation

New Orleans proposes brake inspection twice a year at a flat fee of fifty cents.

In Switzerland four wheel brakes are compulsory.

New York regulations specify that a police officer sit beside the driver, and with the car traveling at 15 to 18 m.p.hr., give the command to stop. If the car stops within 30 ft. the brakes are considered satisfactory. Police do not favor special testing machines.

New York City Police Distances
(Four Wheel Brakes)

M.p.hr.	Stop Made, In ft.
10	6
15	12
20	28
25	38
30	65
40	120

S.A.E. comment is that this is a little too exacting, and recommends special marking devices and means for determining the various factors entering. (S.A.E. *Journal*, Oct., 1923; *Abstracts*, Nov., 1923, p. 21.)

Insurance

Certain insurance companies have allowed a discount from premiums for collision and property damage insurance on motor vehicles using four wheel brakes, requiring a warranty that the insured undertake to use all diligence and care in maintaining the efficiency of said brakes. The reduction amounts to 10 per cent on collision rates and 5 per cent on property damage rates.

General

Brake Drum Area: Empirical formulae giving lb. of car weight per sq. in. of braking surface should specify the speed of rubbing. Little comprehensive data are available, but common practice is to allow 12 to 20 lb. of car weight per sq. in. of wheel brakes, and two or three times this weight for transmission brakes. Provision for dissipating the high heat concentration obtained in the latter, has been made in some cases by providing a flanged brake drum into which the driver can inject water for cooling.

Equalizers: Practical considerations are principally responsible for the divided opinion of engineers on brake equalizers. A properly equalized set of brakes will be more effective than those not properly equalized. However, should a link or pin fail, the other brake becomes less effective. If the coefficient of friction of the two brake bands varies, the braking effort will not be the same, even with equalizers. Equalization becomes more important at severe braking, and under these conditions there is considerable stress in the brake rods, shafts, and levers. The condition in itself produces a certain amount of inherent equalizing of brake effort.

Correct Location of Brake Levers: Brake levers must be so located as to prevent the changing of the brake band position when the car body moves relative to the axle. The body motion arises from loading, horizontal and vertical inertia effects, and spring action due to torque reactions. A familiar result of trouble with brake lever location is the reaction on the foot pedal or hand lever while braking the car over a rough road. The latter produces a spring action which changes the brake effort, and in the case of latched pedals or hand levers, has been known to produce stresses great enough to break the brake control rods or cables. Operating levers should be arranged at such angles to the rod as to produce maximum movement at the beginning of action, and maximum leverage for full braking.

A comprehensive paper by Walter C. Baker ("Correct Location of Brake Levers," S. A. E. *Journal*, June, 1919, p. 508) deals with this subject, and describes a simple measuring device for locating the center for the link eyes.

Running-In New Brakes: In order to overcome the rapid initial wear of brake bands, and to avoid early adjustment of brakes caused by irregularities in their surface, they are frequently run-in for a short time at moderate speeds. A water cooled drum is used to avoid excessive temperatures. The actual wear on the brake is negligible, as evidenced by long service of bands used for prony brakes in the laboratories of Armour Institute of Technology.

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"Say it with brakes and save the flowers,"
A pretty good hunch for this world of ours,
Where everyone whizzes and rushes by
With a sneerful snort and a raucous cry,
Where no one's supposed to be doing well
Unless he is riding for leather'n' hell—
Step on the gas, boys————into the grave,
Think of the flowers a feller could save!
"Say it with brakes and save the flowers,"—
Good for the people, good for the powers,
Good for the man in the buzzing bus:—
Good for the birds on the curb who cuss;
It's good for you and it's good for me,
One smack of a crack of a fine idee,
For this speed-mad crazy old world of ours.
"Say it with brakes and save the flowers."

McEvoy—*Chicago Tribune.*

"Better to strive and climb
And never reach the goal,
Than to drift along with time
An aimless, worthless soul.
Aye, better to climb and fall,
Or sow though the yield be small,
Than to throw away day after day,
And never strive at all."

ENGINEERING IN CHINA

(Continued from page 130)

ally specified to be machine-mixed but beyond a locally-made mixer and a hoisting tower for high construction, operated by steam or electricity no equipment is expected or required. Modern wheel barrows or concrete buggies are rarities, and chuting equipment has never been used here to the writer's knowledge, concrete generally being carried and dumped from two wicker baskets or wood buckets hooked to ropes at the ends of a bamboo pole carried on a cooly's shoulder. This bamboo pole with baskets is also invariably used for carrying bricks, sand, and stone. The only variation in procedure is the number of coolies and baskets, since one cooly can carry two small baskets or two coolies one large basket. The Chinese wheel-barrow is used for heavier loads and longer distances. It has a wooden wheel about three and one-half feet in diameter at the center of a wooden frame, without a tray. The load is placed on both sides of, and directly over the wheel, so that balancing and pushing it requires a special knack. Balance and propulsion are effected mainly by a strap across both shoulders. No power shovels, steam pile-hammers or other modern mechanical equipment are used, except a few motor trucks for general haulage. The inference should not be made, however, that all this lack of modern tools and equipment is due to ignorance. Cooly labor is paid about twenty cents per day or about two cents per hour, and more skilled labor twice or at most three times that rate. Imported tools and equipment are expensive, and with gasoline recently reduced to fifty cents per gallon, labor-saving construction generally means high construction costs. With a population of over four hundred millions to draw upon for the labor requirements of the comparatively small amount of modern construction work carried on in China, no labor shortage need be feared.

The future of engineering here depends upon politics and foreign credit. One large irrigation and land development project near Shanghai is actively seeking foreign funds and has a commission touring Europe and America at present to interest foreign capital. The bankruptcy and corruption of the government and the prevalence of lawlessness and disorders, however, probably do not seem inviting to foreign investors. Furthermore, Chinese and other capitalists in the foreign settlements have funds available at interest rates from twelve to twenty-four per cent, but will not invest in enterprises outside of the settlements because of the insecurity of such enterprises. A result of this condition is the high value of land in the settlements.

When engineering activity does increase in China, the opportunities for American engineers will depend chiefly on the extent of American investments here and the degree of control of these investments. American funds loaned to European nationals serve to release the credit of our competitors for reinvestment in foreign fields like China and in consequence European engineers would probably get opportunities here not then available to American engineers. At present America is probably not in need of trade with China to the extent that the European nations are. But with over-production of manufactures combined with a slump in domestic consumption, trade with China may serve as a desirable field not only for surplus products but also surplus engineers. The Chinese are a shrewd and practical people inured to a low standard of living and a keen struggle for existence. They are fully awake to the advantages of bargaining with representatives of one nation in competition for influence and trade against those of another nation, and have no compunctions about using this advantage to the greatest effect. Thus American engineers as well as American products to be successful here must not only prove their worth for service in China, but must do so against the keenest European competition. And furthermore they have an increasing Chinese competition to contend with as the result of a ready absorption of European education and ideas by the Chinese. Therefore China should not be thought of as an Elysian field for young engineers with a pioneering spirit, as many European and American engineers have thought who came, saw, and went away. The fact remains, nevertheless, that China's chief needs of better and greater means of transportation, protection from floods and drought, and development of mining, agriculture, and industry, constitute a future opportunity for engineers. It is hoped that in view of the general good will which the Chinese people hold for America, this opportunity will be of interest to American engineers.

SPARKS FOR THE ENGINEER

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It will be noticed that for the first twenty years on the chart the increase in gross losses was somewhat in advance of that representing burnable values, but since that time the two lines have been growing further and further apart. In other words, since fire prevention began taking root in 1890, the normal increase in our national fire waste has been much retarded.

The fire ratio represents the number of dollars burned annually out of every one thousand dollars of burnable value. Since 1890 there has been nearly a sixty per cent reduction in this amount, which after all is the barometer of the practicability of fire prevention. Since this amount has been steadily decreasing it is reasonable to conclude that fire prevention is practical, and that intelligent effort expended along this line is worth all of the time and energy contributed.

Early reports on the 1923 loss are optimistic, for it looks as though a small reduction has actually been made in gross losses themselves, which is something hardly expected even by the most hopeful. In any event there is a good reason to believe that much more has been actually accomplished in the cause of fire prevention than most of us suspect, and the engineer of today can scarcely consistently ignore the importance of schooling himself in this interesting branch of his activity.

MY REMINISCENCES OF ARMOUR INSTITUTE

(Continued from page 138)

transformed to the silent and intangible. For they rushed out to me, those etheric pulsations, infinitely rapid, and to all the wide horizon—the potential of coal bound there inert for centuries, now liberated and seeking the last rest, Equality!

"And the Responder heard them in their journey earthward, caught their silent vibration and translated them into sound. So I harkened, and a great awe stole upon my heart as I gazed across the silent waters to that speck upon their rim, and heard the message from the Deep."

I have always felt deeply indebted to Armour Institute as one of the first stepping stones of my career; as enabling me, through its fine facilities so generously offered, to make my first start in wireless engineering. Had it not been for its cloisters, permitting me to work out those first primitive problems, there is little doubt that I could never have accomplished what I have been permitted to achieve in the radio art subsequently. It was at the beginning of this period in Chicago that I made the accidental discovery that a Welsbach gas burner was sensitive to the sound of my spark transmitter, thereby opening up a line of thought which eventually led to the discovery of the Audion.

Dependability is a man's greatest asset. It breeds confidence, and confidence means more and greater responsibilities, and more responsibilities mean more money.

BUSINESS TRAINING FOR ENGINEERS

(Continued from page 133)

both physical and socio-economic, in which it is located. It is highly desirable for the engineer who wishes to understand the reasons for much of what he has learned about the functions of a business to study these other broader fields. The location of a plant for example is conditioned by the geography of the possible cities; their proximity to markets, both for the raw material which it uses and for the merchandise which it expects to sell; their relation to sources of labor supply, of power, and so forth. Marketing problems are largely controlled by geographical conditions, especially in relation to the distribution of population and transportation difficulties. Personnel problems are seriously affected by the previous history of individuals and their nationalities, which in turn are profoundly affected by geography. It is highly desirable for the engineer to become acquainted with some of the outstanding geographical facts[19] and their relation to business.

Quite as important as the physical environment of business are the economic laws and societal traditions with which it is bound. Many are so familiar to all, and are taken so much for granted that their true significance and the way in which they have developed are not appreciated. It is very necessary to survey them,[20] at least briefly. Many of these customs have been crystallized into statute laws. Others have been changed into a more flexible form of law known as common law. It should be appreciated that the law follows rather than precedes customs and that it is constantly changing, ever growing expression of our civilization. All business men should know a little about that portion of the law which relates to business,[21] not with the idea that they can become their own lawyers—a dangerous undertaking—but rather that they may realize the vastness of the subject. More especially, however, they should endeavor to gain an idea of how their business is guided and controlled by law.

Economics has been a much misunderstood subject. It has too often been thought to be possessed of laws as immutable as those of physics.

It is now being more fully appreciated than formerly that the relationship of economics to human life is close, and that persons are so unknowable that economic laws are not inflexible. Economic laws are rather the first approximations which are subject to modification with an increase of knowledge. In studying economics one is studying business in mass or in large section rather than individual companies. It is necessary for all executives to get that perspective of their business which can alone be secured from a study of economics.[22]

To understand the present it is necessary to have some acquaintance with the past. The study of industry and commerce[23] should not be a dry-as-dust poring over dates and names, but should be a stimulating interpretation of many present day conditions which would otherwise be obscure. One of the greatest handicaps under which business men and, indeed engineers, are laboring is a dearth of knowledge of the background of the present.

In the brief space available for this article, it has not been possible to do more than barely outline the scope of the training in business which the engineer (who expects sooner or later to step outside of his specialty) should have. It may well appear that the extent of this training is beyond the possibilities of anyone who does not have three or four years to devote to it. On the other hand, there are few engineers who cannot find a little time to devote to consistent reading concerning some of the subjects mentioned in this paper. For the present at least the day of narrow specialization is gone. The trend is to seek out the man who not only knows his own work, but also knows where it fits into the world's work. The successful man of today must understand enough of the problems of others to work effectively with them. Since the relation between engineering and business is becoming closer, the engineer who expects to render a full measure of service to society, and who hopes to attain that personal success to which he may aspire, must have a general knowledge of business principles and practice.

[19]See Ellsworth Huntington, et al, "Business Geography" (John Wiley & Sons, Inc.), J. Russell Smith, "Commerce and Industry" (Henry Holt & Co.) and Isaiah Bowman, "The New World" (World Book Co.).

[20]See Marshall and Lyon, "On Economic Organization" (Macmillan Co.).

[21]See J. J. Sullivan, "American Business Law." (D. Appleton & Co.)

[22]See Irving Fisher, "Elementary Principles of Economics" (Macmillan Co.).

[23]See Clive Day, "A History of Commerce" (Longmans, Green & Co.), Katherine Coman, "The Industrial History of the United States" (Macmillan Co.) and G. T. Warner, "Landmarks in English Industrial History" (Blackie & Son, Ltd.).

[For a much more extensive bibliography on business see "Reading Lists for Students of Commerce and Business Administration" *Universal Journal of Business*, March, 1924 (University of Chicago Press). Now reprinted in pamphlet form.]

ALUNITE

(Continued from page 134)

gives an acid solution with alum in solution. When a mixture of these two solutions came together, as was often the case in the evaporator, aluminum oxide was immediately precipitated, oftentimes completely blocking the tubes of the evaporator. When either of the two above-mentioned conditions existed, there was great trouble with filtering the soluble from the insoluble portion of the residue. However, when the calcination was properly done, a practically neutral solution of potassium sulphate was obtained, together with a granular alumina residue. This permitted concentration by triple effect evaporators and crystallization by cooling.

Research attention was now directed to further end-products of the ore. Potash alum was made by calcining the alunite ore so as to drive off only a portion of the sulphur trioxide and then dissolving the mass in sulphuric acid. By fractional crystallization practically pure potash alum and sulphate of alumina were produced. Other methods of making potash alum were developed.

The manufacture of optical glass for range finders, field glasses, and other war uses, was imperative. Hydrated carbonate of potash of high purity was necessary in the process, because very slight impurities greatly impaired the light transmitting power of the glass. It was produced from the high grade sulphate of potash made from alunite. Double decomposition with barium carbonate was the method used. The resulting crystals had an average purity of better than 99.75 per cent, some lots running as high as 99.95 per cent. A plant producing about two tons a day was built in three weeks. This product materially hastened the making of superior optical glass.

Permanganate of potash for gas-mask use and other special purposes was made electrolytically from the carbonate on a laboratory scale. All the other ordinary compounds of potash were prepared from the alunite material.

The demand for potash during the war left a considerable accumulation of alumina residue. Thousands of tons were piled up waiting for further research so as to permit its utilization. This residue analyzed about ninety per cent aluminum oxide on a dry basis. Methods were developed for purifying the alumina. The metal aluminum was made by the ordinary electrolytic method. Refractories were made from it that were not only extremely heat-

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CHARLES STEINMETZ

(Continued from page 142)

more conservative elements of that party. He accepted the nomination of that party for various offices, and the support given him by the state is indicative of the people's faith in his ability.

The scientific works of Dr. Steinmetz are so well known, even in their diversity of subject matter, that a separate mention is almost superfluous. We might, however, mention a few of the various subjects upon which he thought, wrote, and talked. Books on astronomy and meteorology, geometry and algebra, electro-chemistry, electrical machinery, electrical circuits, and higher mathematics are some of the subjects into which he delved very deeply. We are all familiar, from numerous, recent newspaper accounts, with the million volt lightning generator produced at Schenectady, under his direction. Protective devices, arc lamps, electric lights, magnetic circuit devices, and various types of motors are among the list of patents granted to him, numbering into the hundreds, during the last few years. He has made innumerable original investigations, mathematical, electrical and physical, and has presented papers on these before various national and international societies. A number of these have been far reaching in their scope, and astounding in their revelations.

ALUNITE

(Continued from page 153)

resistant but also practically acid-proof. High temperature refractories made in the electric furnace, using this residue, are being manufactured on a commercial scale. Crucibles suitable for metallurgical work were produced. Through the electric furnace, abrasives were developed rivaling alundum and carborundum. Sulphate of alumina was produced for paper-making and water purification.

The scarcity of nitrogen compounds, essential for both explosives and fertilizers, drew our research to another field. By means of the electric furnace, aluminum nitride was produced containing over twenty per cent of fixed nitrogen. A working plant was built with a capacity of twelve tons of product daily, and successfully operated. The ending of the war removed the necessity, and the plant was closed. In the various experimental runs during the development of this furnace, aluminum carbide was often produced. Metallic aluminum was also produced by direct reduction in this furnace. Aluminum nitride when treated with alkali in the Bayer Process yielded ammonia and pure alumina. Aluminum nitride when exposed to chlorine gas and heated produced aluminum chloride, which volatilized and was collected by condensation. The reaction was exothermic, and proceeded just as long as aluminum nitride and chlorine were supplied. The product is used in the manufacture of dyes and in the cracking of crude oils.

The crude alumina residue from the manufacture of sulphate of potash, as well as alunite itself, has prominent catalytic properties. Alunite used alone, or the residue impregnated with a vanadium compound, acts as a catalyzer for converting sulphur dioxide into sulphur trioxide. A sulphuric acid process was developed on this principle and put into operation. This latter catalyst also assisted the oxidation of ammonia to nitric acid.

Further research is being carried on, and it may well be that a commercial outlet for alunite may be found, and that notwithstanding the handicap of distance and necessarily high freights this ore may contribute materially to the needs of our people.

FRATERNITIES

(Continued from page 150)

The Faculty smoker, as scheduled, held sway on February 29. The goodly number of professors helped keep many a weakening brother from the clutches of the Leap Year Worshippers on that eve of their celebration and we trust that all who attended the Smoker cared for no other entertainment that evening.

TRIANGLE SCANDALS

The thrill that comes once in a life time was experienced by the Triangle men at the last initiation, April 12. Brother Bob Mayo, who like Brother Carlson, was out of the city at the time we were installed as a chapter of Triangle last May, was initiated as an Alumni member of Triangle. Bob came down to the house a few days prior to the formal initiation, and thereby was given the pleasure of performing some of the intricacies which his own fertile brain had concocted for the benefit of the pledges in bygone days. We commend Bob for his excellency of execution.

The new men initiated on the 12th of April are:

R. S. Mayo, '23
C. Goedhart, '26
S. E. Streeter, '26
A. J. Keating, '26

Our latest social activities consisted of several informal Saturday evening dances, our Faculty Smoker, March 28, the Founder's Day Banquet at the Lumbermen's Exchange Building, April 15, and a Hard Times Dance, April 26. The Hard Times Dance is an annual event at which we all cut loose and have a rousing good time. There was not one idle moment in the entire evening, and it was a hilarious crowd that started for home in the early hours of the morning.

Armour Chapter of Triangle loses eight seniors this spring. The following men will graduate:

Sweeney, Nelle, McDowell, Swartz, Goodmanson, Keene, Davidson, Walworth. They are all good men, tried and true, and we wish them every success in the professional field.

PHI PI PHI

After a month of toil at school, Gamma chapter of Phi Pi Phi was in the proper mood for the annual Cotillion which was held on Saturday evening, March 22. Rudy Lowe and his "gang" coupled with the many and unique favors could not help but put the guests in a peppy mood and make them long remember the Cotillion Party.

Then, having settled down to the usual grind, the boys decided that one month was long enough to go without having a little amusement, the result being the Easter tea on Easter Sunday, followed by a theatre party to the Garrick.

The old boys have been dropping in quite regularly of late, among those seen since our last writing being "Petey" Bond, the giant, Gerry Schumacher, and Ray Malwitz. All seem to be making good use of their training at Armour.

The boys have settled down now once more and are lengthening their stride for the home stretch. No social events have been planned until the conclusion of school. Our Dinner Dance on May 24, at the Sisson, will then end our social season.

SIGMA ALPHA MU

Spring brought with it an occasion for which our chapter had been planning for many months. This was the Midwest Conclave, with Sigma Epsilon chapter as hosts. May 2, 3, and 4 were devoted to the conclave which included a smoker, a formal dinner, a formal dinner dance, and, of course, business sessions. Our guests included many out of town visitors as well as Armour alumni.

The chapter has increased by these three men:

E. V. Buchsbaum
H. Cohn
H. B. Ritman

who were recently initiated.

SIGMA KAPPA DELTA

Sigma Kaps have thrived upon a balanced ration during the past few months, said ration consisting of several smokers and dances culminated with the annual initiation.

On March 14, the faculty met us in our "native lair" and emerged seemingly none the worse except for a few trimmings at bridge.

Jenks Bryan and his band helped to make our House Dance on March 29 a success. April 4 and the following day were devoted to introducing eleven men to the mysteries of our brotherhood. On April 5, the initiation and annual banquet was held in the Fraternity Room of the Great Northern. Several of our charter members were in attendance.

We held our Annual Dad's Smoker on the evening of April 26 and on May 11, Mother's Day was appropriately observed by a gathering of our mothers at the house. The final House Dance to be held on May 17 will close our activities for the current year.

SODALES

This organization has never graced the pages of The Armour Engineer before, therefore we take pleasure in giving its readers a short account of our history. Sodales is a social club organized at the Armour Institute of Technology in February, 1923. Four members of the Class of 1923, C. Meyers, E. Arentz, E. Prentiss, and F. Hess are alumni members of Sodales. There are at the present time eleven members four of whom, H. Karow, R. Grahn, E. Hanson, and C. Shaffer will graduate this spring.

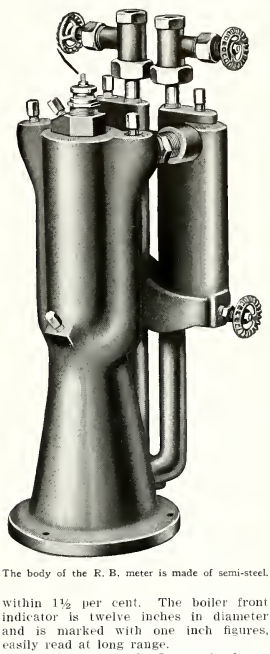
Flow Meters for Small Plants

The more elaborate flow meter installations are often thought inadvisable in the plants operating a few boilers of 100 hp. capacity or less, and in the plants with numerous smaller units that are gradually being replaced with larger boilers.

Still, efficiency is just as desirable there as elsewhere, so to meet the need for adequate steam measuring in these plants, the Republic Flow Meters Company has brought out the R. B. Meter. It indicates to the fireman the load carried on each boiler.

The R. B. Meter system is electrically operated and consists of three parts; the meter body, the boiler front indicator, and the medium used to obtain a differential pressure, either of the pitot tube or orifice plate type.

The meter body is built of semi-steel. It is practically a reproduction at a slightly smaller scale of the Standard R. S. Meter body; it reads accurately



The body of the R. B. meter is made of semi-steel.

within 1½ per cent. The boiler front indicator is twelve inches in diameter and is marked with one inch figures, easily read at long range.

With this system the fireman is always kept informed on boiler performance. The R. B. Meter shows up lagging or overloaded equipment. If a sudden steam demand impends, the fireman is warned in sufficient time to provide for it, and when the demand drops off, he is similarly warned to curtail steam production. Thus the R. B. Meter is an aid in securing fuel economy.

Enthusiasm is the dynamics of your personality, without it, whatever abilities you may have lie dormant. You may possess knowledge, sound judgment, good reasoning faculties, but no one will know it until you discover how to put your heart into thought and action. A wonderful thing is this quality we call enthusiasm. If you would like to be a power among men, cultivate enthusiasm. People will like you better for it; you will escape the dull routine of a mechanical existence and you will make headway wherever you are.

—J. Ogden Armour.

THE VACUUM GAUGE

(Continued from page 143)

and sturdy, acquired by a boyhood on the farm. His hair is thin and quite gray and he has the pale face of a student, but he can dig out hedge roots and cube roots with equal facility. He opens the brief case and carefully takes out the mimeograph sheets of examination questions which he had taken home with him the night before. No youthful Houdini will get an advance tip on the calculus examination if Professor Palmer can help it.

With the question papers in hand he walks down the hall to room C where the class is already assembled. The sheets are distributed quickly, each man scanning the questions hurriedly in search of one that he can answer. For a few moments the place is like a courtroom when the clerk rises to read the verdict of the jury. The silence soon becomes less oppressive however, as here and there an ambitious but nervous worker, anxious to get the job started, drops his pencil on the floor or searches noisily through a sheaf of scratch-paper for his yellowback.

A step sounds in the hall and a figure appears in the doorway. He has a quiet "good morning" for the professor and a look of fatherly concern for the students, many of whom seem to be in trouble. Here is an expert on vacuum gauges; he has seen so many of these semi-annual affairs that he can approximate the final reading from the visible signs. On many faces he sees a look of quiet self-confidence, on others a faint glimmer of intelligence, on a few an expression of complete vacuity. As the gauge needle swings back and forth he decides that in this class the vacuum will be about normal. He is anxious to offer what encouragement he can, and his reassuring smile seems to say, "Don't take it too seriously, boys."

After a keen survey of the room the visitor leaves, his retreating footsteps, a trifle slower now than in years gone by, sounding down the hallway. It is Dean Monin, making a round of the classrooms where the readings of the vacuum gauge are being recorded. Many a conscientious student who feels that examinations have him at a disadvantage and that he often fails to do his best, feels better after the Dean's brief visit. His air of quiet dignity and friendly interest helps to banish the worries and the fidgets, and the whole class buckles down to the task before it with increased confidence.

Dean Monin's next port of call is a classroom at the other end of the building. As he enters the door the professor in charge rises briskly from his chair and receives his guest cordially. He is just a trifle puzzled however by a look of mild alarm which he detects in the dean's face. The professor has the diction of an English purist, the manners of Chesterfield, and the figure of Falstaff; Professor Finnegan and his class in Special Hazards.

The dean is a versatile man and he knows something about hazards, special and extra special. His look of concern as he entered the room was due to one of the latter which he recognized; the little folding chair on which the professor was sitting. Chairs are at a premium just now and this one was intended for Professor Winston, but was put in the "Hazards" room by a mistake on the part of the "yanitorial" department.

For three days the examinations continue amidst a certain amount of inevitable confusion which results whenever a regular routine is interrupted. In the hallways and on the stairs little groups of students are conducting sorrowful postmortems, and speculating on the possibility of a C. In the electrical laboratory the Chorus brothers, Anvil and Alibi, are discussing the examination in A. C. machinery. The former is panning the professor for confining his questions exclusively to the hardest part of the subject. Alibi knew the answer to every question in the list and would certainly have made 100 per cent, but they wouldn't give him time to finish.

In the different offices the members of the faculty are busily engaged marking the papers. As the work goes on one finds it easy to create, in imagination, a personification of Armour Tech students, past and present; a figure which stands at the professor's elbow and in a low voice speaks to him as he works. "Remember, professor, you have spent a lifetime in the study of this particular subject; you are an expert, your students novices, so don't expect perfection. If a question is answered, not as you would answer it, but as well as you can reasonably expect from your student, mark it A."

When the papers are all marked and the grade sheet is prepared for the Dean's office, the wise instructor will find in it not only a record of what his class has done but also a measure of the efficiency of his own teaching. If his standard has been impossibly high, or if he has been more lecturer than teacher, the indicated vacuum will be high. If he has done his duty patiently and conscientiously, not looking for perfection, not satisfied with mediocrity, the gauge reading will be a credit to his class and to himself.

J. C. PEEBLES.

THE ARMOUR ALUMNUS

(Continued from page 143)

Public acknowledgment of his services as an engineer was not lacking, for in 1920 he represented the Philippines at the engineering congress held in Batavia.

William A. Douglas, Class of 1921, is with the Pacific Telephone and Telegraph Company, of Seattle. For some time after leaving A. I. T., Mr. Douglas was with the Illinois Bell Telephone Company in Chicago, where he gained valuable experience in the engineering side of the telephone business. He likes the West very much but doesn't admit that he is ready yet to settle down and become a fixture at any particular job.

Earl W. Porter, '15, is secretary of the Inglewood Chamber of Commerce. Inglewood, California. This looks like a far cry from architecture, which was Mr. Porter's course in college. However, it is probable that the Chamber of Commerce will be interested in public buildings, zoning laws, and all measures for the improving and beautifying of the city. In this connection he will be able to apply his architectural training for the betterment of his community just as surely as if he were engaged in active practice of the profession.

The Armour alumni association has suffered an irreparable loss in the death of **Alexander N. Grossman, '15.** Mr. Grossman although he had been out of college only eight years had made a decided success in life. It was only recently that he had addressed the Armour branch of The American Institute of Chemical Engineers.

Leo Maranz, '21, recently moved to New York City, where he is connected with the Republic Flow Meters Co.

Philip D. Savy, '23, is in a very tasty business. He is affiliated with the Lawrence Ice Cream Co.

SOCIETIES

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his talent as bass violinist in the Orchestra. President Friedman and Jarvis who have been in the Glee Club for four years will also graduate. "Friedie" you will remember plays a trombone in the Band and Orchestra.

The climax of the efforts of the Musical Clubs was attained in the twenty-third Annual Home Concert. The program was featured by a number of pleasing variations along musical lines. Besides the numerous and varied renditions of the Band, Orchestra, and Glee Club, the program contained two special numbers by talent outside the Musical Clubs themselves. These were a piano solo by Mr. Zukawski, and a series of snappy numbers by the newly organized "Tech Serenaders."

The Musical Clubs hereby extend an open invitation to all and sundry, possessing or believing themselves to be possessed of any talent, to try and use such talent in aiding the clubs to a more successful year even than that which is being concluded.

THE ARMOUR TECH DRAMATIC CLUB

We are glad to be able to say that the first year of the Dramatic Club has been a success. Much has depended upon the success of the organization, especially its permanence, as a student activity. Although it took much effort on the part of the members to make it thrive, the results have been well worth the effort. Next year we hope to see an even better and bigger club.

The Vaudeville Night was the initial effort of the club to give a dramatic presentation to the student body. The work of the east was well done and showed the existence of real histrionic talent. The splendid cooperation of the band, directed by W. B. Douglas helped to make a pleasing entertainment. The Jazz Band was a decided hit and will probably appear again in the following year.

The Dramatic Club has selected a charm to be worn by the members. Many of them will soon be dangling from the watch chains of the club members. It is an emblem of real service and cooperation. The new officers for the next school year will be elected shortly.

John Hays Hammond, internationally famous mining engineer, whose work in South African Gold fields is a concrete example of the many, broad, and varied types of problems which education must help a man to meet, says:

"I believe that every professional man, no matter how specialized his work, or perhaps the more so the more specialized it is, must have a foundation in the humanities. Literature, fine arts, history, government, economics, political science, foreign languages—these are part of the equipment of every professional man, whether he be physician, lawyer, architect, engineer, or what not. Without them he can never properly express himself in any direction, and is not able to stand on the same plane with the best of his co-workers."

ABSTRACTS

(Continued from Page 148)

being forced to remain still for sometimes three hours or more, often in uncomfortable positions, and it therefore seemed desirable to develop a tube with a still higher power output in order to shorten the time for treatment. To bring this about Dr. Coolidge devoted himself to the development of an X-Ray tube for this purpose of a greater power than any hitherto known. By increasing the voltage and the current through the tube, he knew that the intensity of the rays would be correspondingly increased. The problem was to design and produce a tube capable of carrying continuously a greatly increased load.

Accordingly, after some time devoted to experiments and research work, he first produced a tube with an anode or target made of a large, flat plate of tungsten with sufficient surface to radiate continuously the energy absorbed when the tube was operated at 30 milliamperes and 200,000 volts, which is equivalent to six kilowatts. The tube was operated in an oil bath which was water cooled. Although this tube gave about four times the output of prior tubes, Dr. Coolidge continued his work until he had developed a still more powerful tube (250,000 volts, 50 milliamperes), again multiplying the output by four, in other words having a X-Ray output about fifteen times that of the tubes then in use for cancer treatment. The new tube is equipped with a water-cooled anode, a seamless metal tube being utilized to conduct the water in and out of the X-Ray tube.

—Journal of the A. I. E. E.

The Fixation of Nitrogen as a Blast Furnace Process

Results of investigations by Richard Franchot as published in *Industrial and Engineering Chemistry* indicate that the fixation of Nitrogen as an alkali cyanide is a by-product of normal blast furnace operation. This represents a tremendous amount of energy which, in the interests of fuel economy, should be put to use. When working at a capacity of forty million tons of pig iron, the American blast furnace is fixing nitrogen at the rate of about six million tons a year, and spending coke in doing it. This is double the rate at which it has been estimated that nitrogen is taken from the soil in crops. In terms of energy, the hearth of the blast furnace in the United States is developing some twelve million kilowatts, of which twenty-five per cent is apparently available for and absorbed in work done at 1500 degrees Centigrade. Of this it appears that one-half is devoted to keeping in circulation as cyanide a large accumulation of alkali. There appears to be power here of the order of two million horse-power, not only developed and available, but already engaged in nitrogen fixation.

The fact has been known since 1840 that the combustion of alkalis and nitrogen form cyanide at high temperatures and rapid rates of heat input. Many difficulties were encountered by experimenters, such as providing the necessary rate of heat input (the reaction being endothermic) and at the same time avoiding excessive volatilization of the alkali. Also, in separation of the cyanide from the by-product gases by condensing, it was found difficult to avoid decomposition of the cyanide into its components.

Patents by McElroy obviate the trouble to some extent by combining the endothermic reaction of formation, with the exothermic oxidation of carbon at high temperatures. This action was observed to take place in blast furnaces by McElroy, the products being carbon monoxide (CO), free nitrogen and potassium cyanide (KCN). It is found that 22 per cent of the charging coke in the blast furnace is used in the fixation of 8 per cent of the atmospheric nitrogen supplied in the air, nearly one-quarter of the fuel energy is therefore wasted.

Diesel Engine Used in New Benz Truck

Benz and Company of Mannheim have announced details concerning its new 5-ton truck fitted with a Diesel engine. The engine works on the true Diesel cycle, using a compression pressure of slightly over 500 pounds per square inch, the fuel charge being ignited by heat generated from compression of the air. No air compressor for injection is used, but there is an ignition chamber in the top of the cylinder in which a small quantity of the fuel ignites spontaneously and forces the rest of the fuel into the combustion chamber in the form of a very fine spray.

It is claimed that the Benz-Diesel engine can be operated on any heavy fuel such as crude oil, that the engine can be idled for any length of time, and that it will carry a full load immediately after an extended period of idling. In external appearance the motor does not differ materially from the conventional truck engine. The individual cylinders have both the inlet and exhaust valves in the head. The valves are enclosed in an aluminium cover and operated by outside pushrods. The ignition chamber is arranged between the two valves. As is customary in engines of this type, the cylinder heads are cast separately. The engine is fitted with a centrifugal governor, a Bosch electric starting motor driving the flywheel, and a preheating tank for fuel in the upper tank of the radiator. Lubrication is by pressure.

—Automotive Industries.

Trans-Atlantic Wireless Telephone Communication

The very recent engineering feat of successfully sending wireless telephone messages across the Atlantic Ocean represents not only a further development of existing principles on this subject, but a new viewpoint regarding the influences which affect reception and transmission. Previous to this, atmospheric conditions were considered of minor importance in the art of radio communication. The only things considered in designing long distance apparatus were the power of the sending station and the sensitiveness and selectivity of the receiving station.

The difficulty in long distance reception is not in the inability to detect the signals sent but rather in the quality of these received messages. Messages have been sent from New York to London for quite a few years but the noise accompanying them and their indistinctness made this reception practically worthless. It was by means of this reception however, that a study of the intervening medium was made. Previous to the final tests, months of experimenting was conducted. By means of very sensitive instruments in London, the intensities of the received signals and the accompanying noise could be accurately measured for every hour of the day. The results of different days showed that the values varied almost in the same way for each day. By making curves for these values, the exact time at which reception was best could be determined. With a sending station of suitable strength and a receiving station of the proper sensitiveness, successful communication was then an easy task at these specific hours of the day. This is one way of minimizing the effect of atmospheric conditions upon long distance reception. But perhaps it is not the best and it seems logical to say that all later developments along this line will be concerned more with atmospheric conditions than with the actual apparatus used.

Here again we see the value of the engineering analysis of a confronted difficulty. Going at a thing in a haphazard way is antagonistic to development. It is only by the careful study of cause and effect that great steps can be made in the progress of any undertaking. This is the engineer's task.

COLLEGE NOTES

(Continued from page 144)

Phi Lambda Upsilon	91.5
Salamander	91.6
Chi Epsilon	93.0

SOCIAL FRATERNITIES AND CLUBS

Sigma Kappa Delta	86.2
Phi Pi Phi	86.1
Triangle	85.7
Theta Xi	85.6
Phi Kappa Sigma	85.1
Delta Tau Delta	85.0
Umen	89.9
Sphinx	89.2
Sodales	88.1
Sigma Alpha Mu	87.5
Rho Delta Rho	87.3

The average of all students belonging to Sigma Kappa Delta, Phi Pi Phi, Triangle, Theta Xi, Phi Kappa Sigma, and Delta Tau Delta Fraternities is 85.6 (Fraternities who rent or own their own chapter houses.)

The average of all other students is 85.6.

In the above, the following numerical values were given to the letter grades: A=97.5 per cent, B=90.0 per cent, C=80.0 per cent, D=67.5 per cent, E=50.0 per cent.

Registration Second Semester 1923-24

	Seniors	Juniors	Sophomores	Freshmen	Specials	Total
Mechanicals	37	34	43	..	..	148
Electricals	33	34	38	54	1	160
Civils	30	16	26	33	2	107
Chemicals	26	21	19	30	..	96
Fire Protection	21	20	28	28	..	97
Architects	9	15	26	27	2	79
Postgraduates	..	..	..	..	..	1
Total	156	140	171	215	5	688

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